RESIDENTIAL FRAGMENTATION AND QUALITY OF LIFE IN NAIROBI CITY

EUNICE NTHAMBI JIMMY

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ABSTRACT

Residential fragmentation undermines interaction and integration in urban areas since it physically excludes some urban dwellers through barriers such as walling, fencing and gating. Research has shown that many cities, especially in the Global South, are experiencing spatial fragmentation issues associated with increasing inequalities, social exclusion and proliferation of gated communities. This results to distinct fragments within urban areas with limited interactions and unequal quality of life (QoL) conditions. Studies have focused on fragmentation, integration and QoL independently with the literature on their association noticeably missing. The main aim of this study, therefore, was to analyse and explain the association between residential fragmentation and QoL using residential fragments (slum, planned non-gated and gated community) in Nairobi city, Kenya.

A mixed method (qualitative and quantitative) approach was employed using secondary and primary data to understand the history and drivers of fragmentation and prevailing patterns. Secondary data enabled classification of the study area into slums, planned non-gated and planned gated and analyse their characteristics. Primary data was collected using in-depth key informant interviews and questionnaires. 415 questionnaires were administered to allow understanding of the level of integration (symbolic, community and functional) and QoL satisfaction. The questions were in 5 Likert scales hence mean and standard deviations, as well as descriptive statistics (percentages and cumulative percentages) of the respondents, were used for analysis of QoL satisfaction and level of integration. To analyse and compare the relationship between integration and QoL, nonparametric correlation matrices were computed. Similarly, independent t-test was computed to compare the mean score of QoL between respondents with high overall integration and respondents with low overall integration.

The findings of the study revealed slum residents felt least integrated symbolically compared to the non-gated fragment and gated community. However, residents in gated areas have lower community integration compared to the slum and planned non-gated fragments. For functional integration, planned non-gated fragment residents were the least integrated compared to the slum and gated community. The QoL analysis revealed that the gated community have higher QoL satisfaction compared to other types of residential fragments. Variability of the QoL in the fragments showed that the gated community has low coefficients of variation compared to the other fragments indicating it has a relatively homogenous in terms of QoL.

The assessment of QoL satisfaction revealed that gated community had higher satisfaction scores compared to the other fragments across the five domains. There is a strong positive correlation between symbolic integration and QoL domains related to the built environment (housing +0.646) and socio-economic domain (safety +0.536) indicating that people who are satisfied with housing also perceive their neighbourhood to be friendly and have a sense of pride and feeling of belonging. Similarly, residents who are dissatisfied with safety in their neighbourhoods also perceived the neighbourhoods to be unfriendly and completely not at home. Community integration strongly correlated positively with relationships within the neighbourhood (+0.519). Finally, infrastructure domain (electricity) correlated significantly and positively with functional integration (+0.589). Using a t-test to compare the mean QoL scores between two groups of respondents; respondents with high overall integration and respondents with low overall integration. The results revealed that the QoL satisfaction mean scores of respondents who felt integrated were higher than the QoL satisfaction mean scores of respondents with low overall integration hence there is a significant difference between the two groups.

In conclusion, combining the study of residential fragmentation and QoL and understanding their association seems to be useful since it helps to understand the urban issues in a multidimensional manner as well as helping planning agencies and decision makers in the formulation of policies that promote equity and integration within the residential fragments. Fragmentation is related to QoL as it is associated with spatial exclusion through barriers and gating, self-marginalization and marginalization of the poor making it harder for them to feel being part of the city. The residential fragments reflect the intense divides between the wealthy suburbs and the marginalized living in the slums with differing QoL and access to basic services.

Keywords: Residential fragmentation, Quality of life, symbolic integration, community integration, functional integration, fragment, slum, non-gated, gated community

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CI	Community Integration
CV	Coefficient of Variation
FI	Functional Integration
GIS	Geographic Information Systems
KNBS	Kenya National Bureau of Statistics
OSM	Open Street Map
QoL	Quality of Life
SI	Symbolic Integration
SPSS	Statistical Package for the Social Sciences

1.   INTRODUCTION

Fragmentation of residential neighbourhoods is a relevant concept for urban research since it is considered as a societal problem that socially and physically excludes some urban residents from interactions hence affecting both their quality of life (QoL) and integration (Levitas et al., 2007). Sabatini and Salcedo (2007) state that fragmentation is concerned with the opposing forces of integration and exclusion. The effects of fragmentation are not always negative since some people choose to self-segregate for social identities, to get better access to public goods and to build communitarian lifestyles (Linares, Mikkelsen, Velazquez, & Celemin, 2016; Sabatini, 2006). This chapter, therefore, details out the need to study residential fragmentation and the importance of analysing its relationship with QoL using Nairobi City as a case study. Sections discussed in this chapter include background information and justification, research problem, objectives and questions, hypothesis and the structure of the report.

1.1.   Background

Modern cities in Global South are made up of distinct well-planned and unplanned spatial patterns known as urban fragments (Balbo, 1993; Balbo & Navez-Bouchanine, 1995). The formation of these fragments may be attributed to historic development and planning of the cities, increasing inequalities and informalities, social and spatial polarization, as well as the proliferation of gated communities (Dupont & Houssay-Holzschuch, 2005; Watson, 2009). When the fragments exist with no integration and interactions, they result in residential fragmentation. Residential fragmentation is defined as a development that causes physical and social spaces to break up into bits that seem independent and detached from each other (Balbo & Navez-Bouchanine, 1995; Burgess, 2005; Landman & Badenhorst, 2012). According to Jacobs (1961), physical barriers such as walls, fences and dead-end streets largely limit interaction, integration and physical access to opportunities among city dwellers. The barriers also contribute to urban inequalities especially when they limit social development that fosters a sense of belonging in neighbourhoods influencing fragmentation. According to Burgess (2005), fragmentation is influenced by the principle of exclusivity whereby upper and middle social classes separate themselves by walls and fences (Caldeira, 2000).

Residential fragmentation can be perceived in two ways. First, as a direct outcome of post-colonial residential planning inherited from colonialism especially in the Global South cities and second as a result of urbanization and globalization characterized by segregated homes of the poor and fortified homes of the rich (Balbo, 1993). For instance in Delhi-India and Cape Town-South Africa, historical development and planning by the British colonial rulers and post-independence by the governments influenced the development of the city space directly contributing to residential fragmentation (Dupont & Houssay-Holzschuch, 2005). In the United States, it is manifested through gated communities of similar white middle-class suburbs (Roitman & Phelps, 2011) while in Latin American cities, it is evidenced by middle-class neighbourhoods bound with walls and gates protecting public areas such as shopping, leisure places and public streets (Borsdorf & Hidalgo, 2010). In Lima-Peru, residential growth in the city is characterized by formal and informal residential patterns, poor land use planning, discriminatory economic opportunities and unequal social stratifications (Peters & Skop, 2007). Similarly, in Managua-Nicaragua residential fragmentation is linked to rising urban insecurities leading to exclusive fortified enclave areas affecting the nature of social relations between social groups with the city (Landman & Schonteich, 2002; Rodgers, 2004).

Residential fragmentation is more prominent in previously colonized countries where social class residential segregation policies and legislation were implemented before and inherited after independence (UN-HABITAT, 2016). In the Global South, differences between better-off and deprived in the society are evident in residential areas through differing means and modes of transportation, access to recreational

areas, political bargaining power and areas for shopping (Smets & Salman, 2016). It is a reflection of the true image of social exclusion in cities depicting the gaps in wealth possession, socio-status inequality, gender and age (de Jeude, Schutte, & Quesada, 2016). Davids and Gouws (2013) see residential fragmentation as the main agent to the proliferation of informal settlements, squatters and slums while Roitman and Phelps (2011) state that it as a result of gated communities. This is because when urban developments are not well planned and managed, they result in intensified inequality and growth of slums (UN-HABITAT, 2017) that affect QoL conditions of urban residents. This further brings about systematic and unbalanced geographical distribution of public services such as education facilities, access to public transport services, health services, water supply and connection and sanitation services among others (K'Akumu & Olima, 2007) hence affecting QoL conditions of groups in those areas (Morgan, 2013).

Studies on residential fragmentation have gained importance in recent studies (Ruiz-Rivera, Suarez, & Delgado-Campos, 2016). However, in Nairobi city, studies and literature on residential fragmentation are noticeably missing. Existing studies (K'Akumu & Olima, 2007; Mitullah, 2003; Muiga & Rukwaro, 2016; Olima, 2001) in Nairobi city analyse residential development and segregation which to some extent explain spatial fragmentation in the city. These studies attribute the current situation of spatial differences in residential neighbourhoods to the colonial regime that laid the foundation of planning. The situation is escalated by increased development of gated communities among the middle and upper-class urban dwellers.

1.2. Research Problem

The city of Nairobi today is considered to have a high spatial disparity with regard to inequalities observed through different neighbourhood characteristics such as differences in housing typology and urban form, access to public goods, infrastructure and services provision. This is also evident in terms of community resources and income (Olima, 2001). The rich live in areas that are well-planned, spacious, serviced with good infrastructure and public services while the poor live in dilapidated, congested, high-density neighbourhoods with inadequate or poor public services. Most of the middle class and upper-class housings in Nairobi share a border with slums with walls and gates, roads or natural features like rivers acting as barriers to separate these settlements (Oyugi & K'Akumu, 2007).

To make the matter worse, the demand for gated communities has been increasing in the city since the elite prefers to live in neighbourhoods serviced with good roads, street lighting, children playgrounds, shopping malls, gymnasium, schools and other amenities (Mbogo, 2017). Living in gated communities in the city is not just defined by having a house (shelter) but having a lifestyle whereby one has privileges to enjoy better and privatized services such as security services, solid waste management and infrastructure among others (Muiga & Rukwaro, 2016). The uneven distribution of resources has sustained the gap between well-off and deprived amplifying residential fragmentation. It is evident that continued residential fragmentation contributes to negative impacts especially in terms of the varying service provision which affect both formal and informal residential housing as well as the residents' QoL conditions (K'Akumu & Olima, 2007). In this case, the poor do not only experience deprivation but are also trapped in poverty as a result of exclusion from the rest of the society (Mutisya & Yarime, 2011).

Residential fragmentation undermines integration of neighbourhoods in cities since it physically excludes some urban dwellers through walling, fencing and use of barriers limiting interaction (Blakely & Snyder, 1997; Jacobs, 1961; Landman & Schonteich, 2002). Research has shown that many cities, especially in the Global South, are experiencing spatial fragmentation issues associated with increasing inequalities, social exclusion, and proliferation of gated communities (Balbo, 1993; Dupont & Houssay-Holzschuch, 2005; Landman, 2011; Watson, 2009). These studies mostly address issues that impinge on the QoL or issues that influence fragmentation and integration such as gated communities. Although this may seem to solve the challenges facing the cities especially in the Global South, it is unclear how QoL domains (e.g. housing,

safety, infrastructure services) are associated to the integration of urban fragments. The association of the two concepts is an important area of study and yet under-researched. A deeper comprehension of the association between residential fragmentation and QoL provides a multi-layered approach to addressing urban problems associated with fragmentation and unequal QoL conditions. This, therefore, underpins the need for this research through analysis of residential fragments namely slum, planned non-gated and gated community through the study of contextualized fragmentation history, drivers of fragmentation and prevailing patterns as well as its association with QoL conditions.

1.3. Research Objective

The main objective of this study is to analyse the relationship between residential fragmentation and Quality of Life in different residential fragments of the city of Nairobi.

1.3.1. Specific objectives

The specific objectives to guide the study are:
1. To understand the prevailing residential patterns in Nairobi
2. To analyse the residential fragmentation in Nairobi
3. To analyse the Quality of Life of residents in different residential fragments
4. To analyse and compare Quality of Life and integration between the residential fragments

1.3.2. Research questions

1. To understand the prevailing residential patterns in Nairobi
   a) How has planning and policy influenced residential areas in Nairobi over time?
   b) What are the driving factors of prevailing types of residential fragments in Nairobi?

2. To analyse the residential fragmentation in Nairobi
   a) What are the classification and spatial distribution of residential fragments in the city?
   b) What are the socio-economic and spatial characteristics of the classified fragments?
   c) What is the level of integration in the residential fragments?

3. To analyse the Quality of Life of residents in different residential fragments
   a) What are the appropriate domains to measure Quality of Life in the residential fragments?
   b) What is the level of QoL satisfaction of different residential fragments?

4. To analyse and compare Quality of Life and integration between the residential fragments
   a) To what extent are the association between QoL domains and type of integration?
   b) What are the variations in QoL between different residential fragments?
   c) What QoL domains explain the integration of residential fragments?

1.4.   Thesis Structure

This research consists of six chapters with chapter 1 presenting introduction, background, problem statement, objectives and questions for the study. Chapter 2 provides the literature review on residential fragmentation, integration and QoL as well as the conceptual framework. It provides the basis through which other studies on the field of residential fragmentation and QoL have been undertaken. Chapter 3 explains the research design, study area, methods, and techniques used for data collection, processing and analysis. It also explains the sampling strategy and ethical issues considerations. Chapter 4 has the results of the study based on the objectives. In this chapter, findings on the residential patterns in the city of Nairobi, and drivers of fragmentation, residential classification into fragments are reported. QoL satisfaction, level of integration derived from the administered questionnaires during fieldwork as well as a comparison of the two are presented. Chapter 5 is the discussion part to explain and interpret the findings connecting them to the literature review. Lastly, Chapter 6, which is the conclusion, and recommendation gives a summary of the study, attained knowledge and provides recommendations and proposes areas for further study.

2. LITERATURE REVIEW

This chapter explains in details and scope of residential fragmentation and QoL based on previous studies and their definitions. It highlights how fencing, walling and gating contribute to fragmentation affecting QoL conditions and integration of urban residents. It also provides dimensions of fragmentation/ integration and domains of QoL. Finally, it details out the conceptual framework for the study. Since fragmentation in cities take different forms and disciplines it is therefore crucial to categorically state that this study focuses on residential fragmentation based on symbolic, community and functional integration within fragmented urban space.

2.1. Residential fragmentation definition and its driving factors

Urban fragmentation is a multidimensional concept that consists of different characteristics and faces that make it difficult to define though easily recognizable (Harrison, Huchzermeyer, & Mayekiso, 2003). Different terms and concepts have been used as either synonym or as notions that are closely related to fragmentation such as spatial segregation; spatial separation; spatial polarization; social-spatial exclusion and disconnected cities (Landman, 2011). Some of the authors use terms like city of fragments, microstates, divided city, dual city, illegal and informal city, gated city and fortified cities to describe fragmentation (Balbo & Navez-Bouchanine, 1995; Landman & Badenhorst, 2012; Louf & Barthelemy, 2016; Low, 2001; Madrazo & Van Kempen, 2012; O'Connor, 2013). Burgess (2005 p.22) states that '*Urban fragmentation is associated with physical obstacles and enclosure with lines drawn around spaces that matte*r'. It is '*a spatial phenomenon that results from the act of breaking up, breaking off from, or disjointing the pre-existing form and structure of the city and systems of cities*' (Burgess, 2005 p.1). In this study, fragmentation is however defined as residential developments that cause physical and social spaces to break up into bits that seem independent and detached from each other with less or no interaction (Balbo, 1993; Landman & Badenhorst, 2012; Shawish, 2015).

Residential fragmentation has to be considered in relation to its drivers, its impact on urban form, integrated development and social stability (Landman, 2011). There are different kinds of literature on the drivers of residential fragmentation in Global South and Global North countries. According to Coy (2006), causes and consequences of urban fragmentation in Latin American cities involve inequalities in the social and spatial character of the cities. These lead to diverging developments of *islands of wealth* in *oceans of poverty* that reflect on the general structure and characteristic of Latin American cities with either internal or external driving forces (ibid). The internal driving factors of the islands of wealth include status, security and lifestyle while that of the ocean of poverty driving factors include marginalization and survival necessities. These factors result in urban fragments such as gated communities, which consequently leads to increase in shopping centers, entertainment centers, business parks and revitalized areas.

Urban planning, residential zoning regulation and policy influence many city patterns which may be a reflection of residential fragmentation. For instance, Global South city planning ignores that greater percentage of the population live in slums with extreme poverty and adopt plans from the Global North (Watson, 2013). This only worsens the urban challenges and conditions of informality, spatial fragmentation, inequality (Watson, 2009). Balbo (1993) highlighted that colonial system in most of developing countries influenced residential fragmentation which was strongly supported by Dupont and Houssay-Holzschuch (2005) giving Delhi and Cape Town cities as examples. The colonial planning ensured distinct areas of the locals and the settlers. The proliferation of gated communities also contributes to fragmentation of residential neighbourhoods through limiting interactions (Borsdorf, Hidalgo, & Sánchez, 2007; Borsdorf, Hildalgo, & Vidal-Koppmann, 2016; Caldeira, 2000; Coy, 2006; Landman, 2006; Sabatini & Salcedo, 2007;

Shawish, 2015). Security issues increase demand for the gated communities. A major impact of gated communities is its effect on social and physical integration as discussed below:

2.1.1. Gated communities and fragmentation

Gated communities are developments that are hedged or walled off from their adjoining environs (Landman, 2000). Blakely and Snyder (1997) defined it as housing developments that have restricted access leading to privatization of public spaces such as roads. The gated community is also defined as "*a housing development on private roads closed to general traffic by a gate across the primary access. The developments may be surrounded by fences, walls, or other natural barriers that further limit public access*" (Grant & Mittelsteadt, 2004 p.913). These residential housings are planned and promoted as spatially exclusive areas with improved facilities and services (Pacione, 2005). However, this study defines gated community as residential developments that are bound by a wall or hedge with control and restriction to public access and the residences have shared practices and communal obligation for management (Atkinson & Blandy, 2005). The physical elements of barriers are believed to lower fear of crime in residential areas in the cities (Abdullah, Salleh, & Sakip, 2012).

Gated communities are a manifestation of the "closed city" which strongly relates to residential fragmentation. People living in gated communities are no longer part of the general society since when they move out of common norms into this closed neighbourhoods where they stay like tourists in the city (Ozkan & Kozaman, 2006). They exclude other city residents living in the adjoining neighbourhoods contributing to social exclusion and destroying social networks (Landman & Schonteich, 2002; Low, 2001). In addition, they consume and occupy more land than the rest of the city for instance in Guadalajara –Mexico, gated communities occupy 10% of the city land but house only 2% of the city population (UN-HABITAT, 2006a). Barriers like walls and fences of these developments redefine social interactions and distances within communities and neighbourhoods enhancing the class status and stigma at extreme (opposite) ends of the scale (Morgan, 2013). Gates, walls, barricades and fences play the role of splitting people at all levels of socio-economic classes. "*The purpose of gates and walls is to limit social contact and reduce social contact*" (Blakely & Snyder, 1997 P. 137) hence increasing social spaces and reducing integration.

Research all over the world has recognized the changing patterns of the residential organization due to increasing levels of crime and insecurity forming 'fortified enclaves'[1] (Caldeira, 2000; Landman, 2000, 2002, 2004; Rodgers, 2004). These enclaves act as barriers to isolate and protect the residences from crime. They are evident in Sao Paulo (Caldeira, 2000), Santiago de Chile and Buenos Aires (Sabatini & Salcedo, 2007), Cape town (Landman, 2002, 2004; Landman & Badenhorst, 2012), United States cities (Blakely & Snyder, 1997) and United Kingdom cities (Atkinson & Flint, 2004). Development of gated communities is seen as the main cause of residential fragmentation in many cities with many studies affirming that gated communities largely contribute to fragmentation (Benit-Gbaffou, 2008; Caldeira, 2000; Coy, 2006; Landman, 2000, 2002; Landman & Badenhorst, 2012; Roitman, 2010; Roitman & Phelps, 2011; Sabatini & Salcedo, 2007).

According to Sabatini and Salcedo (2007), thriving of gated communities have been supported by both supply and demand of residential developments. The supply side is whereby developers tend to prefer development of gated communities than any other type of housing since they offer considerably high-profit margins while the demand side people favour moving to gated communities to get exclusiveness, superior facilities and services, fear of crime among others. Residents working and shopping in these gated communities never require to interact and integrate themselves with the rest of the city (UN-HABITAT, 2006; Watson, 2013).

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[1] Fortified enclaves are demarcated neighbourhoods that are private surrounded by walls and monitored (Caldeira,2000).

2.1.2. Integration and fragmentation

Integration is the elimination of barriers and enclosures that may restrain movement and set up of useful unordered relationships (Marcuse, 2005). It means that spatially distributed resources and assets such as neighbourhoods, public facilities (schools, recreation areas and health facilities etc.) are shared by the members of different groups (Hartman & Squires, 2010). Many studies (Balbo & Navez-Bouchanine, 1995; Deffner & Hoerning, 2011; Kempen, 2007; Madrazo & Van Kempen, 2012) have upheld that residential fragmentation is a threat to urban integration and social cohesion. Fragmentation underscores disconnections rather than connections since it is related with barriers that obstruct choices and opportunities for social connections and interactions (Deffner & Hoerning, 2011). For instance, barriers such as walls may disconnect people from each other making it hard for near neighbours to have physical contacts due to the spatial relations between estates and neighbourhoods and maintain divisions between urban spaces (Jacobs, 1961; Legeby, 2010). Physical barriers that separate neighbourhoods from their surrounding areas are strong forces which reinforce residential segregation and fragmentation for residences weakening integration within these neighbourhoods (Roberto & Hwang, 2016). These may lead to dead ends and cul-de-sacs and restrict social interaction and physical access (Jacobs, 1961). According to Jacobs (1961), gating the neighbourhoods discourage street life which is one of the areas where people enhance social networks and community integration. Integration is equal rights in access to opportunities and public services, common values within community system, sense of belonging, social relations and social networks (Hartman & Squires, 2010). It means all neighbourhoods are open to everyone without attributing to race or status but according to preferences. Fragmented cities portray different characteristics as explained in the following section.

2.2. Characteristics of fragmented cities

Balbo & Navez-bouchanine (1995) identified three structural features and characteristics that are evident in Global South cities which depict fragmentation. These include:

Illegality: This is where the city is characterized by illegal housing ranging between 50% and 80% that do not abide by building codes, zoning and planning regulation. It is called "illegal city".

Informality: This is a situation whereby informal sector makes up a significant part of residential developments in a city (an informal city).

A disconnected city: This is the situation in Global South cities whereby infrastructural services are extended unequally to some parts of the city e.g. the wealthy residential settlements while the low-income areas remain disconnected with such services.

Similarly, (O'Connor, 2013 p. 28) generalized the African cities into six main categories namely "*the indigenous city (related to kingship), the Islamic city, the colonial city, the European city, the dual city and the hybrid*". The indigenous cities' origins are related to kingship institutions based on political powers such as Yoruba towns in Nigeria. The Islamic cities borrow largely the Islam character of Middle East cities and are generally in the savannah belt West Africa and some in eastern Africa. The colonial cities were founded and built by Americans or British to settle Africans liberated from slavery such as Freetown in Sierra Leone and Monrovia Liberia while the European colonial cities were developed with no pre-existing settlement to permanent settlement by Europeans to live and give urban services during the colonial period. Most of these cities have different urban customs, they include Nairobi, Lusaka, Harare and Bulawayo, and their plans borrowed heavily from European town planning. The dual cities are the cities that have developed with a combination of two or more of the described above types while hybrid cities are the cities that have developed significantly after independence through urbanization processes to the hybrid character. These characteristics formed the basis of classifying residential development in the city of Nairobi as explained in the following section.

2.2.1. Classification of residential areas Nairobi

Nairobi city has diverse residential typologies and characteristics ranging from high-income, middle-income low income and even slum residential categories. Many high-income residential neighbourhoods are gated communities and are located near slum areas but separated by buffers such as walls, fences, roads or natural features like rivers. Most slums self-attach themselves to the developed affluent neighbourhoods. This is because these affluent areas provide incentives to the growth of the informal settlements in form of demand for casual workers for housekeeping, security and gardening hence they act as magnets to the informality (Karisa, 2011). In this study, three residential categories (gated community, planned non-gated and slum fragment) were identified as adopted from Babatunde (2015).

Gated communities and planned non-gated

These are developments created by following formal planning process, standards and regulation (Babatunde, 2015; Pereira, 2011). The developments are provided with adequate services such as drainage, access roads, building setbacks, public amenities among others and are well designed in planning schemes (Babatunde, 2015). Planned neighbourhoods, in this study, are gated community (Mugumoini sub location) and non-gated (Nyayo Highrise neighbourhood).

Slums

These are residential developments that happen as a result of inadequate planned and formal housing system in the urban areas particularly to house low-income group because they are affordable and have lower standards (Pereira, 2011). A significant percentage of residents in African cities is concentrated in unplanned settlements. The unplanned neighbourhoods are either informal or slums. UN-Habitat (2006) defines slums as urban areas that are characterized by lack of more than one of the following conditions: durable housing for protection against extreme weather; acceptable living space; with ease to access to safe, sufficient and affordable water; access to adequate sanitation and security of tenure. These areas are mostly illegally developed and are prone to frequent eviction. This study selected Silanga sub location which is part of Kibera slums for the analysis.

2.3. Fragmentation and quality of life: Conceptual and measurement

Studies relating residential fragmentation and QoL are rare. However, several studies show links between the two phenomena. For instance, Jacobs (1961) states that residential layout performs a key role in creating quality urban life. Agglomeration of poor people in the slum fragments is subject to inequalities typified by lack of green spaces, playground for children, inadequate public services and infrastructure, environmental degradation among other (Linares et al., 2016; Olima, 2001; Pacione, 2003b, Sabatini & Salcedo, 2007). Residents living in these different residential fragments are assumed to have different QoL conditions. This is because there is a relationship between people and their daily urban environment that associates socio-economic status with geographic location causing social-spatial variations in quality of life (Pacione, 2003). The QoL domains and integration dimensions and concepts are discussed in the following sub-sections.

2.3.1. Dimensions of fragmentation

Fragmentation is more concerned to explain the opposing forces of integration and exclusion in urban areas (Sabatini & Salcedo, 2007). Therefore, measurement of integration may be used to determine fragmentation of residential neighbourhoods. Krellenberg, Welz, Link, & Barth (2016) provided six complementary dimensions of fragmentation namely morphological, socio-economic, socio-cultural, political-administrative, historical and environmental. The *morphological or physical* dimension of fragmentation is the urban fabric characteristics that explain the physical aspects of the cities such as accessibility and connection between areas (Borsdorf et al., 2007). The *socio-cultural* dimension is the physical and symbolic aspects that explain social inequality, symbolic restrictions and degree of social cohesion components (Veiga, 2009, 2012). The *socio-economic* aspect evaluates the spatial allocation of economic goods like industrial location and labour location and business specialization districts (Benit-Gbaffou, 2008). *Political-administrative* describes

diversification of administrative units and their possibility of being integrated into urban management plans (Benit-Gbaffou, 2008; Borsdorf et al., 2007). The *environmental dimension* of fragmentation refers to the accessibility, distribution and availability of green spaces and public spaces. Lastly, the *historical aspect* of fragmentation in the city discusses the temporal aspect of fragmentation in a city.

In this study, three dimensions (symbolic integration, community integration and functional integration) adopted from Sabatini & Salcedo (2007) were used. These dimensions relate to dimensions explained by Krellenberg et al., (2016) and Ruiz-Tagle (2013). The three are explained below:

Symbolic integration

This is the level of attachment residents feels towards their residence or sense of belonging. It explains identification with a shared ground, the feeling of being established members or outsiders of a community (Ruiz-Tagle, 2013). This is usually confused with community integration, which involves some level of equality, but symbolic integration occurs under unequal relationships.

Community integration

They are non-hierarchical interactions and contacts with different social groups (Ruiz-Tagle, 2013). Community integration is the social ties created and can be expressed through friendship and networks. It is recognizing or being recognized by others to be an equal member of the neighbourhood. It surpasses the privacy and borders.

Functional integration

Functional integration measure residents' access to public services and facilities. According to Ruiz-Tagle (2013), functional integration measures access to opportunities and services within neighbourhoods and uses distance to opportunity, quality of the opportunities, access to services as well as the availability of public and private institutions as indicators. Access to and availability of services such as recreation areas, sports, electricity and public and infrastructure services (water, education, and health) were used in Nairobi case study.

2.3.2. Quality of life definition and measurement

Quality of Life in this study is defined as "*the relation between perceptions and the feelings of people, and their experiences within the space they live in*" (Senlier, Yildiz, & Aktas, 2008 p.215). It explains the relationship between people and the daily urban environment (Pacione, 2003) especially the spaces they live, recreate, school and get public services. QoL is measured using objective and subjective conditions. According to Martinez, Verplanke, & Miscione (2016), objective QoL is measured by use of observable conditions such as durability of housing, sufficient provision of water, access to public facilities as schools and availability of green spaces. Subjective QoL, on the other hand, is the perceived or self-expressed need as well as satisfaction or dissatisfaction with a certain domain of life (Ibid). Subjective indicators assess QoL perceptions in an urban area (Senlier et al., 2008) and Likert scale is frequently used when undertaking subjective measurement.

Association of both objective and subjective QoL establishes four QoL states namely wellbeing, deprivation, adaptation and dissonance (Berhe, Martinez, & Verplanke, 2014; Craglia, Leontidou, Nuvolati, & Schweikart, 2004; Tesfazghi, Martinez, & Verplanke, 2010). Wellbeing is achieved when both objective and subjective QoL are in good state. Deprivation state exists when both objective and subjective QoL are bad. When objective and subjective conditions differ they result in adaptation and dissonance states. Adaptation occurs when objective QoL is bad but subjective QoL is good while dissonance state exists when objective QoL is good but subjective QoL is bad.

Many studies have used subjective QoL assessment approach in urban studies such as (Costanza et al., 2007; Lee, 2008; Santos, Martins, & Brito, 2007; Senlier et al., 2008; Shumi, Zuidgeest, Martinez, Efroymson, & van Maarseveen, 2015). These studies show the importance and relevance of perceived urban QoL although no empirical evidence to indicate its superiority over objective QoL. This study adopted previous QoL

questions (Babatunde, 2015; Khaef & Zebardast, 2015; Ndungu, 2012) to measure QoL satisfaction in the three fragments. Five domains (Table 2-1) were pre-selected their attributes presented to the key informants for validation during fieldwork. The revised domains are presented in chapter 4. The literature on this section, selected dimensions of integration and pre-selected QoL domains (Table 2-1), a conceptual framework was developed as shown in Figure 2-1.

Table 2-1: Domains of life and attributes.

Domain	Attributes	Supporting literature
Social life	Safety, Supportive friends in the neighbourhood	(Bohnke & Kohler, 2008; Lowe et al., 2015; Senlier et al., 2008; Sirgy et al., 2008; Tonon & de la Vega, 2016)
Access to recreational services	Parks, children playgrounds, green spaces	(El Din, Shalaby, Farouh, & Elariane, 2013; Khaef & Zebardast, 2015; van Kamp, Leidelmeijer, Marsman, & de Hollander, 2003; Witten, Exeter, & Field, 2003)
Access to transportation	Access to bus/ mini bus stations	(Khaef & Zebardast, 2015; Martinez, 2016; Senlier et al., 2008)
Access to infrastructure	Electricity, water	
Access to Education services	Kindergarten, primary school	

Analysis and comparison of QoL and Integration levels will give the relationship.

2.3.3. Residential fragmentation and Quality of life

Fragmentation and QoL are two concepts that refer to different phenomena that are present in the same urban space. Fragmentation and QoL of life are related. This is because the problem of fragmentation in cities is closely associated with intra-urban inequality and variations in QoL conditions (Martinez, 2016). In many occurrences fragmentation processes in urban areas are perceived to be aligned with increasing inequalities in QoL conditions (Caldeira, 2000). The concentration of low-income group represents lower QoL with few opportunities and lack of social interaction with individuals from diverse societal backgrounds hence its connection to social inequality (Sabatini & Salcedo, 2007). Socio-spatial inequalities within cities and social groups encourage social disintegration, which is conceived as harmful to the low-class group shown through the problems of housing and insecurity (Veiga, 2012). Spatial patterns of neighbourhoods reflect the social processes experienced in such neighbourhoods (Skypes, 2011). Neighbourhood differences are manifested through studies of education inequality (Skypes, 2011) and social inequalities associated with spatial segregation (Veiga, 2012). Berkoz (2009) compared satisfaction between gated communities and non-gated neighbourhoods in Istanbul whereby the findings revealed that each residential type considers certain domains of QoL as more significant. For instance, security is more significant gated community while housing is significant to the two types of the residential neighbourhoods (ibid).
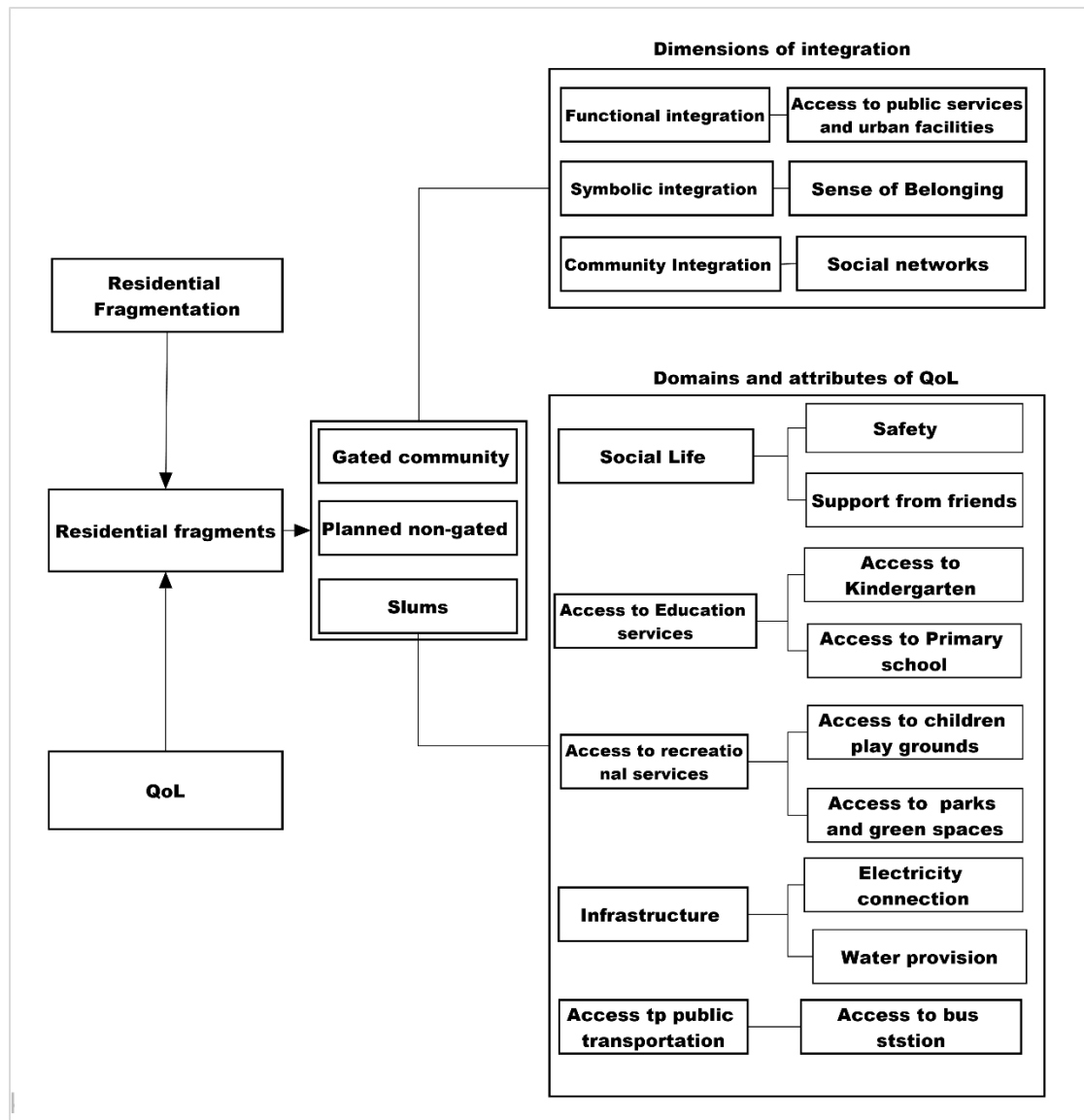
Figure 2-1: Conceptual framework

Sources: Types of urban fragments (Babatunde, 2015), integration dimensions (Sabatini & Salcedo, 2007) and QoL dimensions (Bohnke & Kohler, 2008; Khaef & Zebardast, 2015; Sirgy et al., 2008; Tonon & de la Vega, 2016).

3. STUDY AREA, METHODS AND DATA

This chapter highlights the background information on Nairobi city and describes the research design and methods to achieve all the objectives.

3.1. Nairobi city growth and residential fragmentation patterns

Nairobi city is the capital of Kenya and attracts people from all over the country and Africa. It has estimated population of 3.5 million people. The city contributes more than 50% of GDP to Kenya's economy (Otiso, 2012) and acts as attraction centre for employment to people from all over the country. The city has grown from a population of 11,512 (1906) to 3.1 million by 2009 with current administrative units comprising of 9 sub-counties, 27 divisions, 64 locations and 135 sub locations (KNBS, 2015). British settlers established the city in 1898. Initially, the city was developed as a transportation center and a camp during the building of Kenya-Uganda Railway due to its central location between Mombasa and Kampala and availability of fresh water (Mwaniki, 2017). Residential fragmentation started revealing from the onset and is evident even today (Parnell & Oldfield, 2014) which can be summarized in three phases.

Phase one: As a transportation centre before colonial
This is the initial stages of the city when it was developed as a railway town. During this phase, residential developments were based on railway construction employment classes. Distinct housing estates were developed based on the rank of employment services. The top employees and employers (white) lived at the northern part of the city (Kileleshwa), the middle-class employees (Asians) lived in Ngara areas while the low-income earners (mostly Africans) lived in Shauri Moyo, Muthurwa and Makongeni near the railway station. In this phase, the first plan for the city was drafted in 1898 measuring 18km² demarcating the railway station, trading spaces and zones for first and second class citizens (European and Asians) (ETH Studio Basel, 2008). Later in this phase, the city was established as the capital of Kenya covering seven distinct zones (railway station, the Indian market, the European commercial and administrative centre, the railway housing quarters, the Washerman's "Dhobi" quarters, the European residential suburbs and the military quarters (Owuor & Mbatia, 2008).
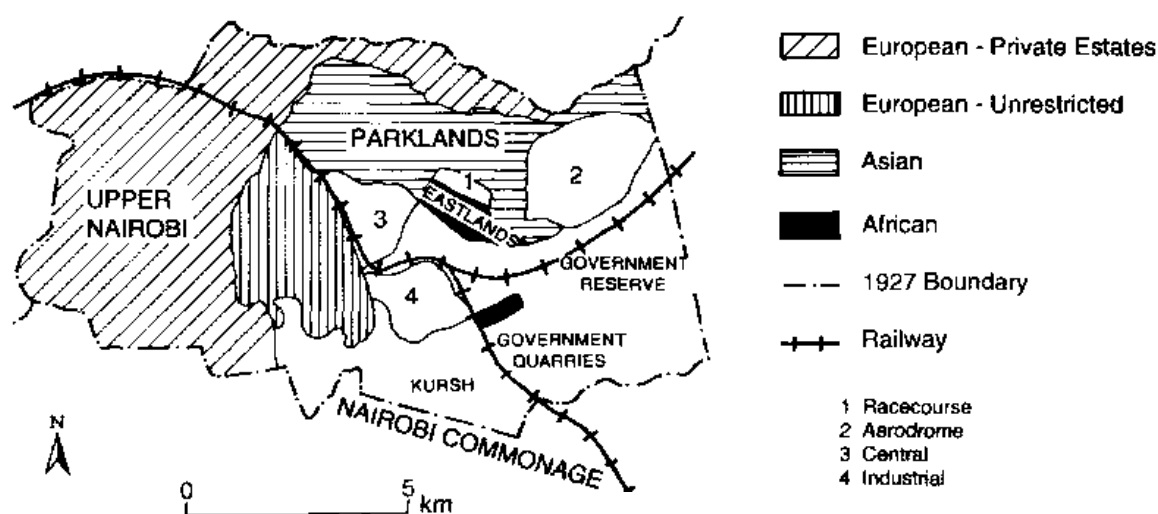
Figure 3-1: The racial residential Zoning in the city of Nairobi in 1909

Source: Mazingira Institute (1993)

Phase two: colonial period

During the colonial phase, racial lines (whites, Asians and Africans) determined the spatial partitioning of the residential areas. *Colonial Capital plan* (*settlers city plan*) was focusing on improving drainage system, clear swamp since the city was developed in the swampy area (ETH Studio Basel, 2008). The first master plan for the city was formulated in 1948 borrowing from international town planning movement during that time (Parnell & Oldfield, 2014). Urban planning methods and policies reflected these classes spatially (Mwaniki, 2017; Olima, 2001). In this time, the city was zoned into four distinct zones namely North and west for Europeans, North and East for Asians, east and southeast for African and South-East to the south for Asian Labourers (Figure 3-1). The whites took the best parts of the city (Kileleshwa, Lavington, Loresho, Kilimani) the Asians occupied Nairobi west, Parklands, South C, South B and the Africans were given Eastlands near the industrial area. The residential fragmentation of the city was continued in *land use zoning plan* proposed in 1898 (Mwaniki, 2017). While the European zones were thoroughly planned and developed with designs and aesthetics conforming to the acceptable standards and densities, the African zones were left to develop unconsciously with the provision of reasonable standard infrastructure such as public health so as to hinder the spread of communicable diseases (Olima, 2001; Oyugi & K'Akumu, 2007). As a result of this zoning patterns, areas inhabited by Africans during this era were characterized by high population density (congestion) and poor service provision (which are indicators of slum generation) (Mwaniki, 2017).

Phase three: Post-independence

The last phase is after independence where the development of residential zones and partitioning of the city shifted from race to socio-economic classes. By the time of independence in 1963, the city boundary had expanded to 680km² and the new regime inherited the existing infrastructure (Olima, 2001; Owuor & Mbatia, 2008). Service delivery type of planning continued to shape the landscape of the city (Mwaniki, 2017) and settlements continued to be determined by social status leading to unequal and/or discriminatory basic infrastructure development (Olima, 2001). The lowest income residents became squatters; Europeans continued to stay in high-income areas who were joined by high income, educated and successful African businesspersons; middle-income Africans joined the Asians while low-income residents were constrained to informal settlements and Eastlands. Thus, income status shaped the residential patterns which are still the case of today's patterns. Due to inequality in the residential development, the city has over 130 informal settlements distributed across it (Ngau, 1995) though this number may be more in the current state.

3.2. Case study selection

Two reasons informed selection of the city as a case to study for residential fragmentation and QoL analysis. One, the upper and middle-class neighbourhoods are planned and cover the largest (95%) part of the total residential space but house the least population with 60% of residents living in either slum or informal settlements (K'Akumu & Olima, 2007; Olima, 2001). Two, informality in the city dominates and drives the economy especially through Juakali[2] sector and street vending and majority of the residents belong to the low-income population.

The city is a typical representation of general characteristics of a fragmented city evidenced by illegality character, informality and disconnection. 52% of the residential developments are constructed to a substandard level which has seen frequent collapsing of residential buildings causing deaths (Wafula, 2016). Inequalities between the wealthy and the low-income class are clearly manifested through service provision and connections. The rich live in well-planned neighbourhoods serviced with good infrastructure, public services and green spaces and surrounded by walls while the adjoining poor neighbourhoods are in dilapidated conditions with poor infrastructure and services. Some of these coexisting wealthy slums

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[2] Juakali is a Swahili word with literal meaning 'fierce sun' but for Kenyans it has a meaning of informal entrepreneurship or business which are dominant in the informal settlements and slums

neighbourhoods include Kibera slums bordering Langata, Otiende, Ngumo, Golf course and Southlands estates; Kangemi slums located adjacent to Westlands and Mountain View Estates. Similarly, Mukuru slums bordering River Bank and South B estates; Kawangware and Dagoretti slums located next to Lavington estate and Mathare Valley slums bordering Muthaiga estate.

Kibera division is located in south-western part of Nairobi city was selected for the study (*Figure 3-2*). It has 16 sub locations. Kibera slums are located within this division and tops in the list of sub-locations with a highest total population in the city. The slums have the population density that surpasses the city's average population density (Dafe, 2009). The division has a mixture of all residential typologies ranging from high income, middle income, low-income as well as slums. This informed the purposive selection strategy of the division. Three sub-locations were selected for the study namely Silanga, Mugumoini and Nyayo Highrise. The choice was informed by the fact that they border each other despite their differing characteristics and meet the characteristic of the fragments discussed in subsection 2.2.1. These characteristics are summarized in Table 3-1. The selection of the fragments was also informed by the ease of data collection especially with the limited time resources. Access to the gated communities had to be guaranteed and safety in the slum was considered. The three sub-location have a relatively similar range of total population but different population densities.

Table 3-1: Summary of residential classification and characteristics

	Gated community	Planned non-gated	Slum
Definition	Planned housing development enclosed by walls, fences with secured entrance bound within barriers and gates operated by guard day and night (only residents allowed) resided by middle and high-income earners. The walling is part of the initial plan in these fragments.	Planned residential development mostly flats of at least 4 storey. Some are walled and fenced as an aftermath thought (informally) due to insecurities. No restriction of who gets in. Some are guarded at night resided by lower medium income earners.	Unplanned, overcrowded and semi-permanent developments that are inhabited by the poor who live in extremely deprived conditions. Some have adopted strategies to informally gate their communities due to insecurity.
Settlement pattern	Island-like form with each island connecting to the main road with one or two small roads and dead end (cul-de-sacs) roads within each island. Mostly bungalows and maisonettes. Occupy large tracks of residential land.	Developments with way through roads and are commonly flats. Most are densely populated but occupy reasonable residential space.	Development with no particular form of no planning. Mostly iron sheet, mud and makeshift houses. Row housing typologies. Have the least urban space but house more than 50% of the city population.
Major reason for living in the neighbourhood	Safety from crime and violence (62%)	Affordable cost of living and close to CBD and places of work (45%)	Affordability of housing and living standards (87%).
Main services	Tarmacked roads, main sewer, piped water into dwelling, electricity, street lighting, access to recreational and leisure places, shopping malls, education and health facilities. Most of the services are privatized. Well designed with good landscaping and green spaces and children playgrounds.	Some are tarmacked and some earth roads, some connected to sewer others septic tank. Connected to electricity, some residents have to travel a long distance to access public recreational and leisure places, served by public facilities (education and health).	No planned roads only narrow footpaths, have common water points to buy water, shared pit latrine and some are illegally connected to energy, recreation services out of the neighbourhood, crowded and congested public facilities such as schools and hospital. Any open space is used as a dumping site.

Source: Author, 2018
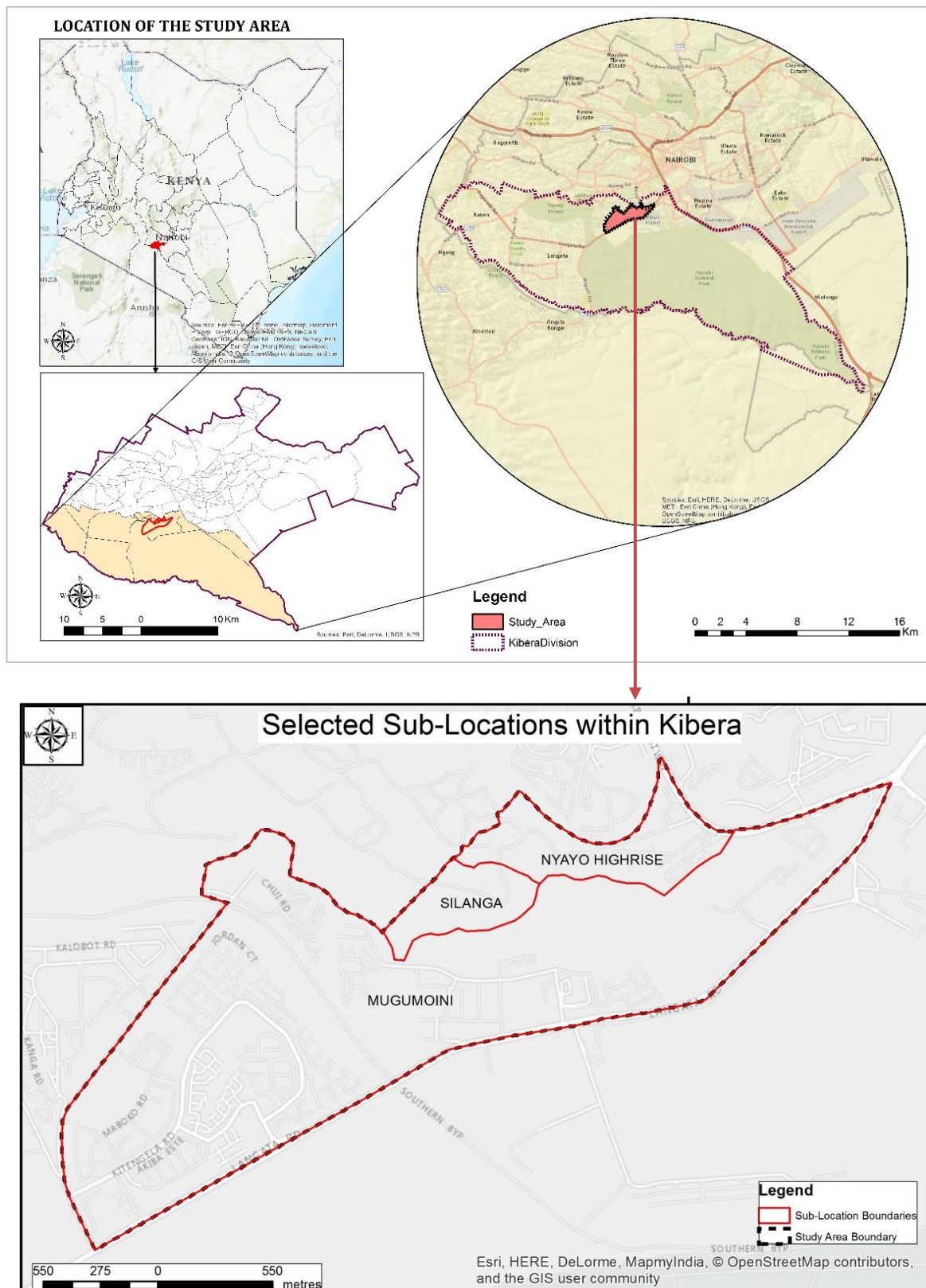
Figure 3-2: Contextual map of the selected areas of study in Nairobi city

3.3.   Research strategy

A case study approach was used (Bryman, 2012) to operationalize the sub-objectives and questions of this study. This provided a manageable scope to allow in-depth analysis with an interpretive approach. Case study approach is an experimental way that helps to study the contemporary phenomenon in an actual situation (Yin, 2009). Therefore, this helped to understand residential fragmentation, its history and main driving factors as well as QoL satisfaction and level of integration of the three residential fragments. Although many studies have criticized the use of case study approach for the reason that they are not generalizable in some cases. This study, however, upholds argument of (Creswell, 2014) who firmly holds that researchers persist in using case study approach that gives them success in thoughtfully planned research of real-life situations and contemporary problems.

A mixed-method research approach (Bryman, 2012) was employed for data collection and analysis. This was through integrating quantitative and qualitative (QUANT-QUAL) methods (ibid). In mixed method approach, qualitative and quantitative methods enable triangulation and complementation of each other in order to develop strong argumentation on the undertaken study (Bryman, 2012; Martinez et al., 2016; Tonon, 2015).

3.4.   Data sources and software requirement

The study used both secondary and primary data sets. The secondary data included census data (2009), sub-locations boundary shapefiles and aerial images. This was obtained from KNBS, Nairobi city county and google earth images respectively and enabled classification of the residential areas into a gated community, planned non-gated and slums. It also helped to analyze the socio-economic characteristics of the classified residential fragments. The primary data was collected in the field through key informant interviews and household questionnaires. A summary of the used datasets is provided in Table 3-2.

Epicollect5 data collection tool was used for the administration of the questionnaires. To execute the analysis, ArcGIS, Excel and SPSS software packages were applied. The key informant interviews were transcribed for qualitative analysis. Similarly, literature review complemented the data collected especially in explaining the history of planning in Nairobi and factors influencing the residential patterns.

Table 3-2: Summary of datasets used and their sources

Type	Format	Year	Source
Aerial image	Image	2017	Google maps
Population and demographic data	Statistics (excel)	2009	KNBS
City Boundary and sub locations	Vector (shp)	2009	KNBS
Socio-economic characteristics	Excel sheet	2009	KNBS
Planned and Unplanned residential areas	Excel sheet	2009	KNBS
Roads	Vector (shp)	September 2017	OSM
Crime hotspots	Vector (shp)	September 2017	MapKibera
Water points in the slums	Vector (shp)	September 2017	MapKibera
Buildings, plots and building footprints	Vector (shp)	September 2017	OSM, MapKibera
Education facilities	Vector (shp)	September 2017	OSM
History of planning and development of residential in Nairobi, Previous plans of the city	Descriptions discussions	Field	Informants interviews
Functional, Symbolic and community integration	Questionnaire	October 2017	Field
QoL	Questionnaire	October 2017	Field

3.5.   Pre-fieldwork

This phase mainly involved fieldwork preparation through an intensive literature review on the previous studies on residential fragmentation and QoL. In this phase, identification of domains of QoL and fragmentation was done. A base map was prepared for Kibera division and the selection of the three sub-locations was undertaken. Classification of the types of the residential housing in the study area was visualized into planned gated, planned non-gated and slum. Interview guide and questionnaires annexed in this report were prepared based on the research questions and objectives.

The final questionnaire form was transferred to an electronic data collection software, Epicollect 5. This tool is based on an open data kit that was developed by the Imperial College London to allow collecting and submitting geotagged forms, pictures and videos to a central project website (Imperial College London, 2018). The process involved creating a google account for the project (fragmentation.qol@gmail.com), creating a project website at epicollect.net, naming and designing the questionnaire form (for this study the form was named "Nairobi fragmentation and QoL") for the data collection. This followed installation the EpiCollect5 App in five Android tablets and loading the project and testing. The forms were updated during fieldwork phase, following comments and validation of the domains of QoL by key informants. The actual data collection was conducted (offline) and each day entries were uploaded (online) to the main website and downloaded to check any inconsistencies. A detailed systematic process is explained in Appendix 1

3.6.   Fieldwork phase

This phase basically utilized for primary data collection. Several activities were executed during the fieldwork phase. These include:

- Study area reconnaissance
- Key informant interviews
- Sampling strategy
- Research assistant training and pilot testing
- Household survey

3.6.1.   Study area reconnaissance

Field reconnaissance was conducted on 3rd and 4th October 2017. This entailed visiting the different residential fragments in the study area, making general observations, getting a conceptual view of the area and taking photographs (example in figure 3-3). This helped the researcher to familiarize with the study area. During this time, local names for the areas were identified and accessibility to the gated communities was also assessed.

Figure 3-3: Reconnaissance in Mugumoini (a) and Silanga (b)

3.6.2. Key informants (semi-structured interviews)

Key informant interviews were conducted to validate the domains of QoL to ensure they were specific and relevant to the study area. The interviews were conducted on 5th and 6th of October 2017 involved senior lecturer and researcher in University of Nairobi, director of development management and regularization Nairobi City County and senior private practising planner. The interviews were undertaken using semi-structured guiding questions (Appendix 2) and the discussions were audio recorded to be transcribed later. According to Bryman (2012) and Edwards and Holland (2013), semi-structured interviews provide an environment for deep discussion to get rich data and they are flexible since the researcher can ask follow up questions. The interviews provided additional information that was not captured during literature review especial on the historical patterns of fragmentation in Nairobi and drivers residential fragmentation in the city. From the interviews, various levels of security controls in the residential fragments were discussed which are escalating formal and informal gating which were later confirmed during household survey.

The interview was divided into three parts. Part one discussed prevailing patterns of residential fragmentation in Nairobi and drivers of fragmentation. Part two was affirmation on the classification of the residential neighbourhoods using the classified map and part three was to discuss the relevant domains of QoL in the city. The identified domains were used to finalize the questionnaire before household surveys thus the interviews were conducted before the questionnaire administration.

3.6.3. Sampling strategy

Two-stage purposive sampling was employed for the study area selection. In the first stage, Kibera division was selected out of the 27 divisions in Nairobi city based on the characteristics and presence of diverse fragments. In the second stage, three sub locations (Silanga, Nyayo Highrise and Mugumoini) within Kibera division were picked purposively ensuring slum, planned non-gated fragment and gated community strata were represented.

Within the three sub locations, and due to lack of a sampling frame in the slum area and full access to the gated community, quota sampling was employed for the selection of respondents. Quota sampling[3] is suitable for interviewing groups of people especially for a case study design with different characteristics that are clustered under one group or community (Neuman, 2014). In the case of Nairobi, quota sampling ensured the proportional number of males and females in relation to each fragment. Based on population density in the fragments, a final sample of 449 respondents was targeted which composed of 220, 102, and 127 questionnaires in the slum, planned non-gated fragment and the gated community respectively. To enable spatial distribution of respondents, the quota sampling was slightly adapted to the characteristics of each area. In the slum area, one participant per structure in every 8th household was selected along the main roads. The planned non-gated fragment, which is composed of densely populated flats, 2-4 respondents, were interviewed per flat. Finally, in the gated community, interviews were conducted where the researcher was granted access. At the end of data collection, 415 questionnaires were administered since the researcher was denied access in some of the gated community states and no replacement was possible.

The selection of the key informants for interviews was purposive since only the experts with experience and hand on information for the city's residential development were needed for the interview.

3.6.4. Research assistants training and pilot testing

The training of five field assistants and pilot testing were conducted after updating the QoL domains suggested by the key informants. The criteria to select the assistants were that they had to be planning students in the third or fourth year of their study and with previous experience in data collection, especially

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[3] It has been used for the selection of research participant in other studies, e.g. to study the difference between social networks and social ties between residents in different social classes in China through interviewing 400 residents (Yanjie, Breiger, Davis, & Galaskiewicz, 2005).

in the slum. The research assistants were trained on data collection ethics and method as well as the use of Epicollect 5 data collection tool to ensure data quality. The training entailed going through the questionnaire to ensure understanding of the questions and coming up with common local terms to be used across the five assistants that would ensure the respondents understood each question. After training, a pilot test was carried out on 10th October 2017 in Silanga area (see figure 3-4). This was to test the questions and the sampling strategy to be used during the actual questionnaire administration. The researcher was able to make any required correction before the actual data collection. From the pilot testing and after talking with few residents, it emerged that the slum neighbourhoods were not safe and the researcher could only be guaranteed of their safety if they hired known local residents to be part of the survey process. Two local youth residents recommended by researchers at the University of Nairobi were then taken in to be part of the survey.

Figure 3-4: Research assistants' training (a) and one assistant pilot testing in Silanga (b)

3.6.5. Household Questionnaires

The questionnaire was administered to capture the level of integration and QoL satisfaction. Questionnaire administration is a very key method of data collection since the information collected can be aggregated and quantified (Bryman, 2012) and it provides a fixed range of answers especially if closed. The questionnaire had both closed and open-ended questions prepared using 5 Likert scales as annexed in the report (Appendix 3). The questionnaire comprised three sections which are:

Section 1: Integration (measurement of fragmentation). This part had questions on functional integration, symbolic integration, and community integration. The functional integration included access to services and public facilities; symbolic measured sense of belonging and perception of pride as a member of the neighbourhood and community integration assessed social networks (Sabatini & Salcedo, 2007).

Section 2: QoL satisfaction. The questions in this section assessed the satisfaction of the residents on the selected QoL domains as identified from the literature and affirmed by the key informants. The domains of QoL included physical and built environment, public services, infrastructure services, socio-economic and institutional services.

Section 3: Respondents' information. This entailed questions about the background of the respondents such as gender, age, employment status, the highest level of education, marital status and time stayed in the neighbourhood.

A total of 415 questionnaires were administered and geocoded. The exercise was undertaken on weekdays and weekend (gated community) to be able to interview professional employees in gated communities. For clear visualization of the geocoded primary data and due to the scale of the fragments, the study area was

divided into two (*See figure 3-5*). This is because the gated community area is larger than the combined area of the planned non-gated and the slum. Figure 3-5 shows the locations of the respondents in the study area.
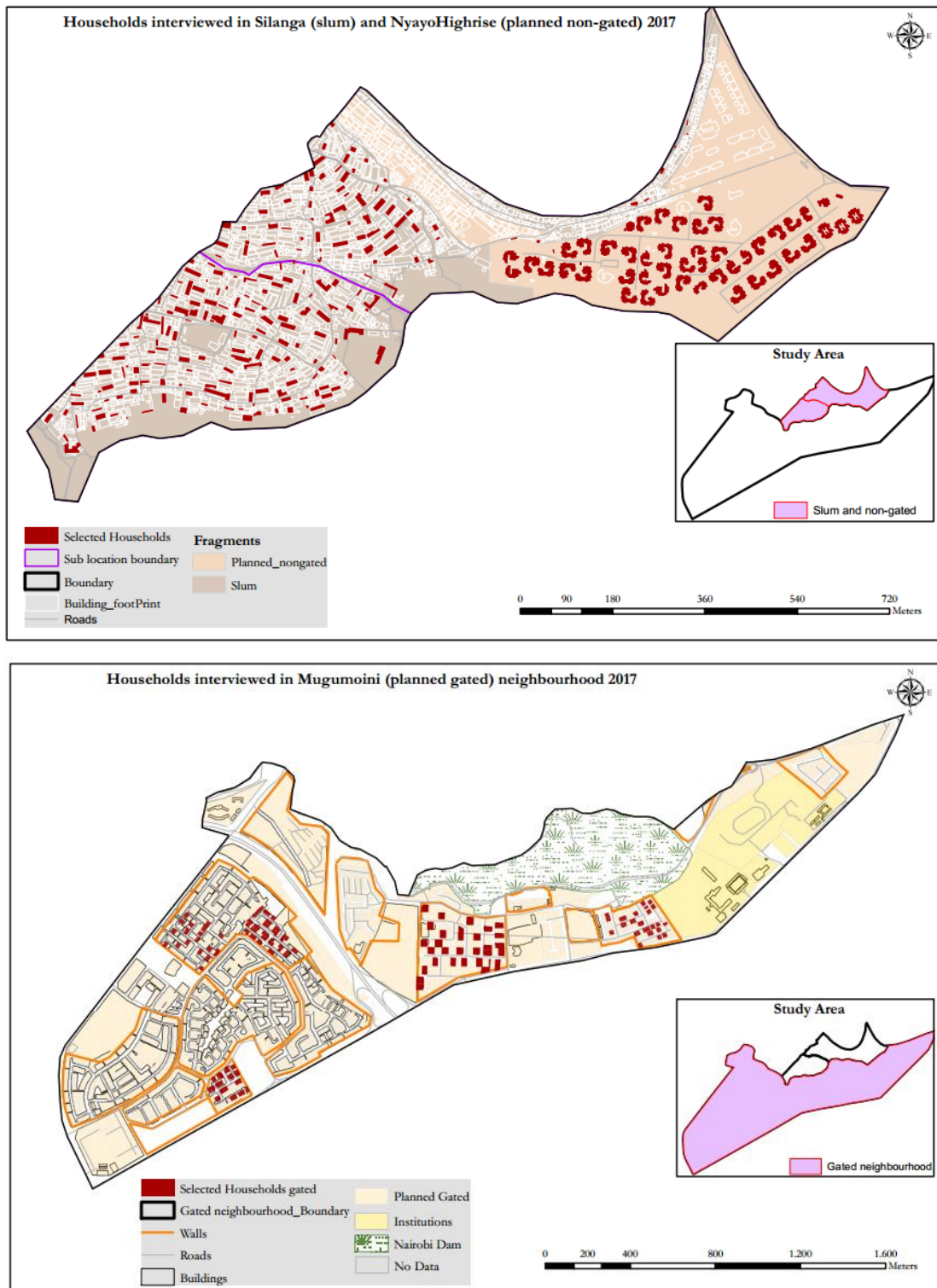
Figure 3-5: Households interviewed in the three fragments

Respondents' characteristics

The final responses gathered from the questionnaires were 415. The number of females was 214 (52%) slightly higher than males (n=201; 48%). Majority of the respondents from the survey were between 26 and 44 years old (n=257; 62%) with the lowest from elderly age group above 65 years (n=3; 0.7%). Majority of the respondents were married monogamous (n=234; 56%) followed by never married (single) and widowed (n=134; 32% and n=21; 5%) respectively. The highest level of education completed by the respondents have a majority with university undergraduates and postgraduates (n=146; 35%) followed closely by secondary education (=129; 29%). Interestingly, 5% have no education skills. Concerning employment, 60% (n=247) were employed either formally or informally while 40% (n=168) were not employed. Majority of the respondents have lived in their neighbourhoods above 6 years. This is between 6-10 years and over 10 years (n=134;32% and n=131; 32%) respectively. to be interviewed, the respondent had 18 years and above and a resident of one of the fragments.

3.7.   Post-fieldwork phase –data analysis

This phase entailed processing, analyzing and interpreting the qualitative and quantitative data collected to answer the research objectives and questions. The secondary data (census) was aggregated to sub-location level (fragment) since it was available at the household level to analyze the socio-economic characteristics of the classified residential typologies. The audio discussions from the key informant interviews were transcribed into Ms-word text. The transcribed interviews were used for analysis and discussion of the history of residential fragmentation, prevailing patterns of residential fragmentation and drivers of the fragmentation in the city of Nairobi.

Quality of life analysis

The questionnaire data in Epicollect5 was exported to SPSS for statistical analysis. Since the questions were in 5 Likert scales, mean and standard deviations together with descriptive statistics such as percentages and cumulative percentages of the respondents were used for analysis of domains of QoL following Boone and Boone (2012); Turksever and Atalik (2001). The QoL analysis was carried out using sixteen attributes within five domains as shown in Table 4-8. Mean score was used to aggregate QoL satisfaction per domain in each fragment as well as the overall QoL to rank the three fragments. Coefficients of variation (CV) were computed to analyse variability of the QoL by dividing the standard deviation by the mean scores (Tesfazghi et al., 2010; Turksever & Atalik, 2001) both per domain and overall QoL. GIS software was used to visualize the satisfied and dissatisfied responses in the fragments. Five attributes that showed varied CV were selected for visualization.

Integration analysis

Three dimensions of integration adapted from Sabatini and Salcedo (2007) were used for analysis of level integration in the three fragments. These included 4 indicators of symbolic, 4 indicators of community and 7 indicators of functional integration as shown in Table 3-3. Descriptive statistics, mean, standard deviation and coefficient of variations were computed in SPSS. An overall integration mean score was also computed based on the 15 indicators to rank the fragments.

Table 3-3: Integration dimensions and indicators used for analysis

Dimension of integration	Indicators
Symbolic (sense of belonging)	Neighbourhood friendliness, feeling at home, sense of pride as a member of the neighbourhood and feel belonging to the neighbourhood.
Community (social networks)	Interaction with neighbours, asking for help from the neighbours, neighbours asking help and social interaction with adjacent neighbourhood residents)
Functional (access to public services and urban facilities)	Sports areas, recreational facilities, kindergarten services, primary education services, health services, connection to electricity, and access to drinking water.

To analyse and compare the relationship between integration and QoL, a nonparametric correlation matrix was computed using the mean score of symbolic integration (SI), community integration (CI) and functional integration (FI) dimensions and all attributes of QoL based on the 415 responses. After correlation of the entire data (415 questionnaires), the attributes that were statistically significant at a confidence interval of 99% with either moderate (coefficient between 0.3 and 0.49) or strong (0.5 and 1) relationships were selected to be correlated with symbolic, community and functional integration across the three fragments. Finally, Independent t-test was computed to compare the mean score of QoL between two groups of respondents; respondents with high overall integration and respondents with low overall integration. The overall integration mean score of 3.89 was used as the cut point for the two groups. The overall methodology workflow is summarized in Figure 3-6.

3.8. Ethical consideration

Fox, Suryanata, Hershock, and Pramono (2006) proposed three ethical protocols to be followed during data collection in communities. First, the researcher is required to explain the objective of the data being collected. Second, the researcher should seek informed consents from the respondents or stakeholders. Finally, the researcher should explain the potential consequences in the neighbourhood once the information is collected, analysed and reported. These protocols were adhered to during the interviews and questionnaire administration. The researcher also upheld the protection of the respondents by ensuring confidentiality and privacy treating the respondents' profiles anonymously.

To ensure data quality, the research assistants were trained and each day's data could be downloaded and checked for any discrepancies. The researchers from the University of Nairobi recommended the assistants selected. Before the start of the questionnaire administration exercise, permission was sought from the local authorities such as chiefs in the respective sub locations. Emails were sent to the key informants to book appointments early in advance and place of meeting agreed to ensure proper preparation of the respondents.
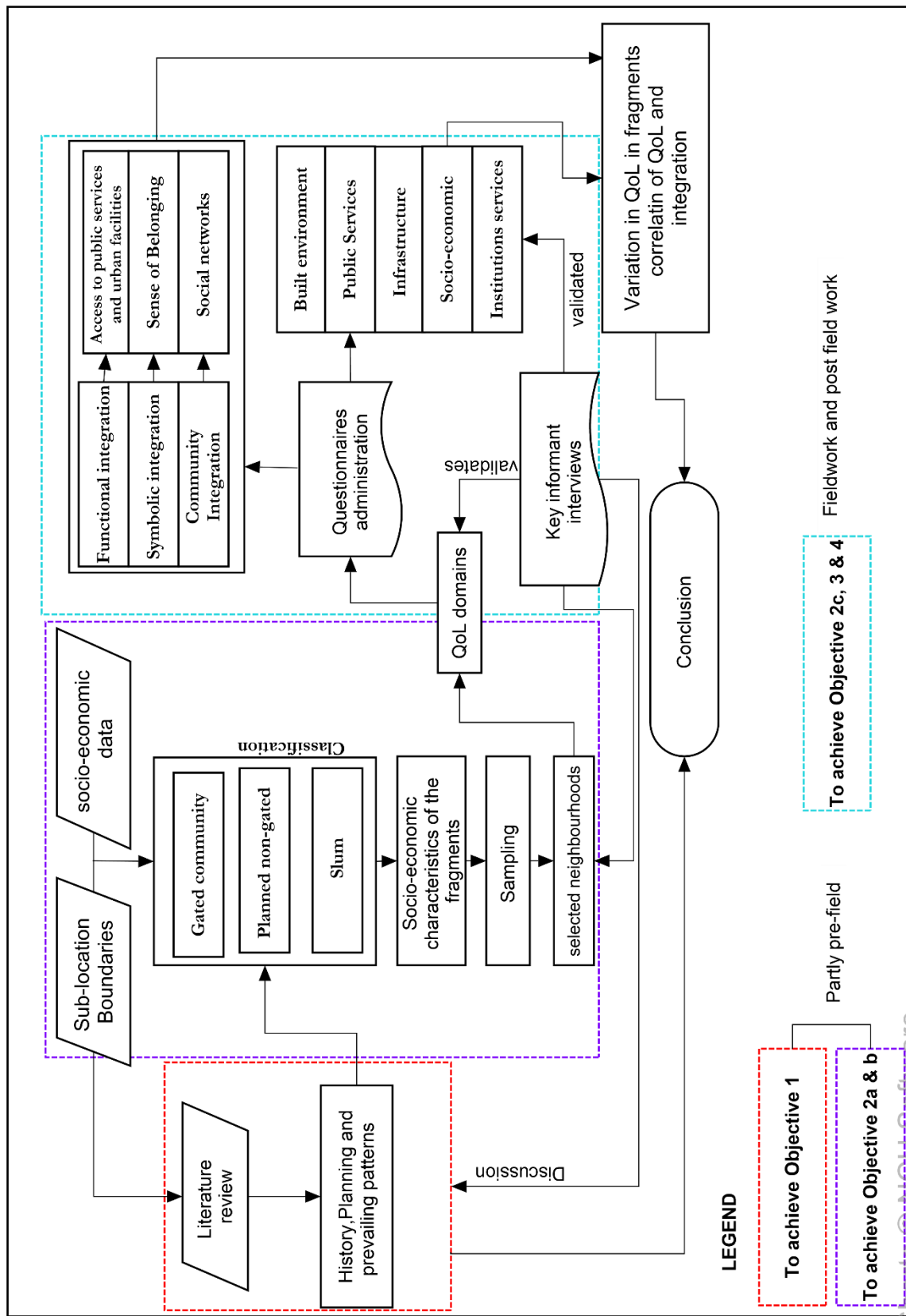
Figure 3-6: Overall methodology workflow

4. RESULTS

This chapter presents results on the prevailing residential patterns in Nairobi, integration and QoL satisfaction for Mugumoini, Nyayo Highrise and Silanga sub locations classified into gated community, planned non-gated fragment and slum. The findings are based on the research questions and objectives of the study.

4.1. Prevailing residential patterns in Nairobi

This section expounds the history of the development of the city and contribution of planning and policies on residential fragmentation as discussed in chapter 3 section 3.2. Drivers of fragmentation are also discussed under this section.

4.1.1. Influence of planning and policy in residential development and fragmentation

The key objective of planning in cities is to provide more equitable development and reduce differences in the residential areas regardless of the social status of the inhabitants (Balbo & Navez-Bouchanine, 1995). However, in Nairobi city, findings from the in-depth key informant interviews show that planning and policies contribute to the residential fragmentation. This is because the plans and policies developed for the city tend to favour the middle and high-income residents leaving the poor to opt for cheaper ways of finding shelter through squatting and living in informal settlements. For instance, one of the respondents argued,

> *"The influence of planning to the current residential development in the city can be explained from two perspectives. The first is the lack of planning for low-income housing. We don't seem to be very keen as planners and even architects as myself, in dirtying our feet and planning in these areas. But the lack of planning is connected with a need for planning. The need for planning also explains why we have not addressed the needs of the poor. Their current and future needs, their social needs, their economic needs and their physical needs in terms of housing and facilities as they need. And the environment where they live."-Key informant 1*

The areas that were planned to incorporate low-income residents in the city such as Buruburu and Umoja comprehensive residential developments are no longer home for the low-income residents due to gentrification. The middle class have replaced the low class in these estates forcing them to live in informal settlements. There are clear and well enforced regulations on densities, plot ratio and coverage, building design, green areas, recreational areas and road of access in areas resided by the upper and middle class but the rest of residential areas continue to develop with no clear standards. This promotes development of slums. One of the respondent stated,

> *"…Like for instance, how did the slums emanate? When the cities were preparing good plans, they did not pay attention to some areas. Along the rivers, idle public land you know, areas that were termed bad or even secluded quarry sites, which were not of interest. So, when they were planning these other areas of Lang'ata and Woodley, this land which someone didn't think much of, they ignored it. And that's how these settlements sprung up." –Key informant 3.*

The (lack of) planning is one of the major drivers of fragmentation in the city leading to polarization, lack of the basic minimum standards, especially on housing and service provision. Figure 4-1 shows an example of a typical aerial view of distinct spatial patterns (slum and gated community) adjacent to each other but only separated by a wall. The gated communities are well planned with clear standards while the housing in the slums are developed without planning. This figure is a typical reflection of residential patterns in the city.

Figure 4-1: Slum bordering gated community in Loresho Nairobi Source: Miller (2016)

Similarly, Figure 4-2 is a simple reflection of how the gated communities are planned with facilities and leisure areas that occupy more urban land than their adjacent neighbours do such as slum and informal settlements that cover minimal space yet house the greatest percentage of urban residents.

Figure 4-2: Kibera slums next Nairobi Golf Club. Source: Miller (2016)

4.1.2.   Driving factors of residential fragmentation in Nairobi

The findings revealed that four main factors influence residential fragmentation in Nairobi city. These can be summarized into the colonial history, planning, security issues and lack of social welfare system (Figure 4-3). The British colonial established the city of Nairobi based on racial spatial structuring. This was the first factor that largely contributed to the inception of residential fragmentation in the city. After independence, the city continued to grow and develop based on economic status leading to both formal and informal structure characterized by disconnections of infrastructure and services in some parts of the city. This widens the gap between the rich and the poor in terms of housing provision and services, increased marginalization of the poor and polarization causing fragments within the city.

The second factor is the government being unable to provide housing for the poor and lack of social welfare system in the country contributing to the increasing demand for affordable housing and increasing the gap between supply and demand. As a result, private developers who are the main housing providers in the country focus on providing housing for the middle and upper-class residents, leaving the poor to live in unplanned settlements. All the key informant agreed on this with one stating,

> *"There is a very big gap between the rich and the poor which the government has not attempted to address through social objectives. Meaning that the government has the social objective of providing housing. But also, they do not have*

a social welfare system of taking care of the have-nots, whom you may call the poor. So there's no distribution of wealth across the board. So that could also be a broader explanation as to why this spatial fragmentation takes place."-Key informant 1.
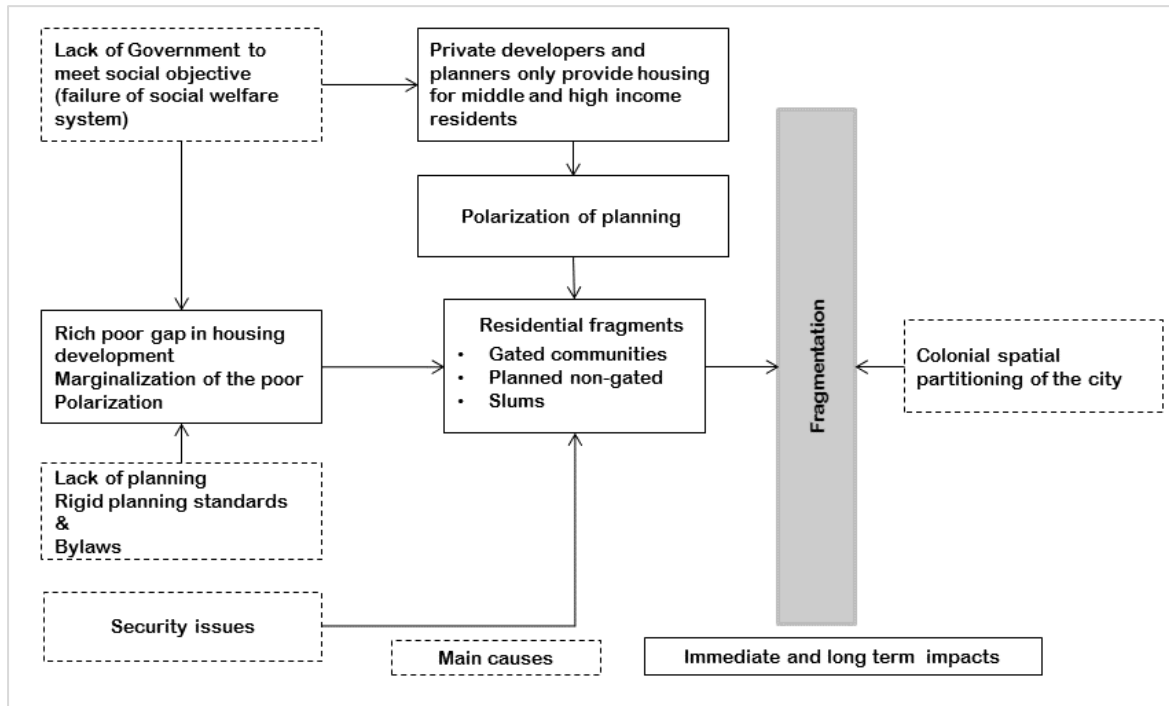
Figure 4-3: Drivers of fragmentation

Security is the third factor and a major concern in the city leading to people opting to enclose themselves in gated areas hence the proliferation of gated communities. *"The social reality for us is that security is a problem... So, to a very large extent, our neighbourhoods are very gated even public institutions." –key informant 1.* Increased insecurity in the city has changed gating systems to different forms (*Figure 4-4*). For instance, a complete gated community at estate level with a security guard at the gates for 24 hours and surrounded by walls where the residences (tenants) have free access but outsiders have to get permission. Second, at estate or building level with security measures at night but during the day, non-residents are allowed. Lastly, at slum area where 20-40 dwellings construct a common gate that has opening and closing time for the residents. This is an informal agreement between the dwellers to have gates to improve security within their structures. The private sector provides services for gated communities. However, since the households in slums cannot afford a security guard, they mutually agree on the time to open and close the gates. These types of gating directly or indirectly limit interaction with residents from other neighbourhoods by isolating the residents from outsiders. The gates create a barrier in common routes or shortcut within the settlements hence people have to find and use other routes to reach their destinations.

Figure 4-4: Gating in Slum (Left) verses gating in gated community estate (right)

Another driving factor is the rigid planning standards and regulations which the poor are unable to meet hence opt to settle in informal settlements, which are affordable to them. The informants strongly felt that the planning standards in the city have been a contributing factor to fragmentation as one stated,

> *"The housing standards, for example, aren't flexible. If you look at Shauri Moyo residential area, when they were done, people were living in one house, but with the services shared. But that was not encouraged. We did not go for flats. Even in Kayole those are supposed to be mansionettes and bungalows. We had set very high standards, kila mtu akue na nyumba yake, sitting room, na mahali ya kuchezea, na hakuna land[4]. There is a scarcity of land. So that delayed the provision of housing, and that's why unregulated estates and informal settlements boomed because we did not have a place to live. And they could not afford the expensive houses that were being built by the private sector. But you see, we were expecting everybody to live there, yet the people cannot afford them. And they are not even enough. So, we would have advocated for more effective housing standards."-key informant 3*

These drivers have resulted in both immediate and long-term impacts on the city structure and have shaped the residential patterns to distinct fragments contributing directly or indirectly to fragmentation as shown by the arrows in Figure 4-3.

4.2. Residential fragmentation analysis in Nairobi

This section identifies and explains the type of residential fragments based on characteristic explained in subsection 2.2.1. Classification of the residential neighbourhoods was obtained using secondary data. This involved using google earth image and knowledge of the study area to digitize walls of the estates in the gated communities.

4.2.1. Classification and Spatial distribution of residential fragments in the city

Figure 4-5 a and b show the three major types of residential developments in the study area. These are gated communities, planned non-gated fragments and slums. The gated community residential area covers the greatest proportion (84%) of the study area, the non-gated covers 11% while the slum covers only 5 %. The gated community also has a strict policy on the minimum plot size allowed for development not less than 0.5 ha as shown in Table 4-1 below.

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[4] Kila mtu akue na nyumba yake, sitting room, na mahali ya kuchezea, na hakuna land (the standards were set too high that every resident had to construct their houses with luxurious living room and playground without consideration of the land available.

Table 4-1: Characteristics of the selected residential fragments

Sub location	Status	Household Number	Total population	Area (Km²)	Population Density/km²	Minimum area allowed (ha)
Silanga	Slum	6,164	17,363	0.20	86,815	0.05
Nyayo Highrise	Planned non-gated and slum	8,414	24,191	0.40	60,478	0.05
Mugumoini	Gated communities	8,478	30,391	3.10	9,804	0.5

Source: KNBS, 2009 and Department of City Planning, 2010
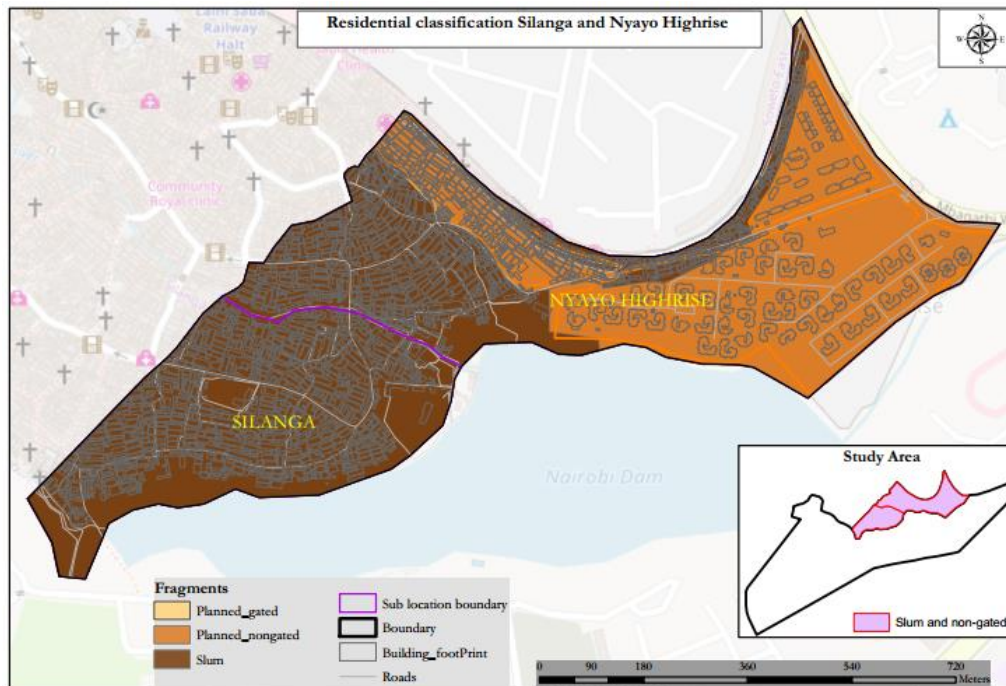
a)
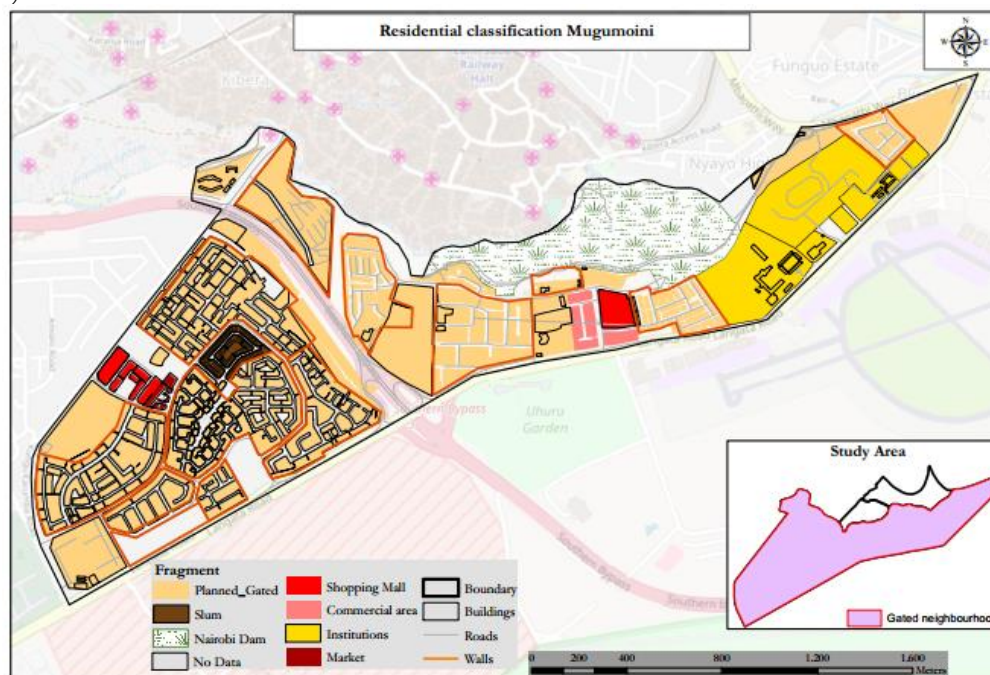
b)

Figure 4-5: Residential classification in the selected sub locations a- Silanga and Highrise, b- Mugumoini

Silanga sub location; Slum fragment

Silanga sub location is part of the large Kibera[5] slums and it is located in the eastern part of the Kibera slums. The slum history is dated back after world war I whereby the British settlers permitted the Nubians[6] to settle in the forest that was at the fringe of the city (Desgroppes & Taupin, 2009; Parnell & Oldfield, 2014). After independence, the state claimed the land and declared Kibera settlement as illegal but the Nubians and other low-income migrants from all parts of the country continued to develop and spread Kibera (Mutisya & Yarime, 2011). Today some of the richest residential neighbourhoods in the city (Karen, Langata, Upperhill) surround the settlement. It is also close to industrial area. The gated communities and the industrial area act as attraction points to provide job opportunities hence more Kenyans opt to come and live in the slums next to the job opportunities. In this sub-location, informal mixed developments are allowed with and minimum plot size of 0.05 with no restriction on density and units per Ha (*Table* 4-1). The slum is characterized by lack of proper housing, adequate access to clean water and sanitation, proper public services and solid waste management (Mutisya & Yarime, 2011).

Nyayo Highrise sub location; non-gated fragment

This sub-location is located in the northern part of Kibera division. It borders Laini Saba and Silanga slums to the west, Mbangathi highway to east and Mugumoini sub-location to the south. Riara University is found in this sub location. The sub location consists of both slum area (Soweto Village) and High-rise middle-class residential developments. The neighbourhood has a barricade, which has no restriction on the public and non-residents. It is zoned for flats only with minimum plot sizes of up to 0.05 Ha (Department of City Planning, 2010). No specific restriction on the maximum housing units allowed per Ha in this area.

Mugumoini sub-location; gated community fragment

This is the largest sub-location of the three selected fragments. It has a population of 30,391 (2009) covering an approximate area of 3.05km^2. The sub-location is composed of gated estates which include Airport View, Dam Estate, Masai estate, Southlands estate, Onyoka, Civil servants, Jambo, Rubia, Uhuru garden estate, Intercity apartments, Choice Place apartments, Zenith apartments and NHC court. In these gated estates, only the residences are allowed to get in. The visitors have to get permission from the guards at the gates. The sub location is zoned for bungalows, maisonettes and flats with minimum plot size ranging from 0.2-0.5Ha. Housing density allowed is 35 units per Ha (Department of City Planning, 2010). Many roads in this sub-location have dead ends or cul-de-sac to prevent traffic.

4.2.2. Characteristics of the residential fragments

To get the general view of the characteristics of the fragments the following analysis were undertaken both on the secondary and the primary data.

Education

Figure 4-6 shows the highest education level attained from the secondary and primary data. The results show that majority of the households in the slum residents have attained primary and secondary level of education level according to the Census (2009). The findings from the primary data revealed the same trend. However, in the gated community and planned non-gated, the majority of the residents fall undergraduate and postgraduate. This gives the general overview of literacy level of the residents in the different fragments.

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[5] Kibera is a Nubian name meaning forest

[6] Nairobi's original Nubian population was recruited from Sudan by the British army. The group was part of the famed Kings Africa Rifles regiment who helped the British to expand their Empire and served them in both world wars. As a reward for their loyal service, the British settled Nubian in a forest at the edge of Nairobi, which they named Kibera.
http://edition.cnn.com/2011/WORLD/africa/05/04/kenya.nubian.discrimination/index.html
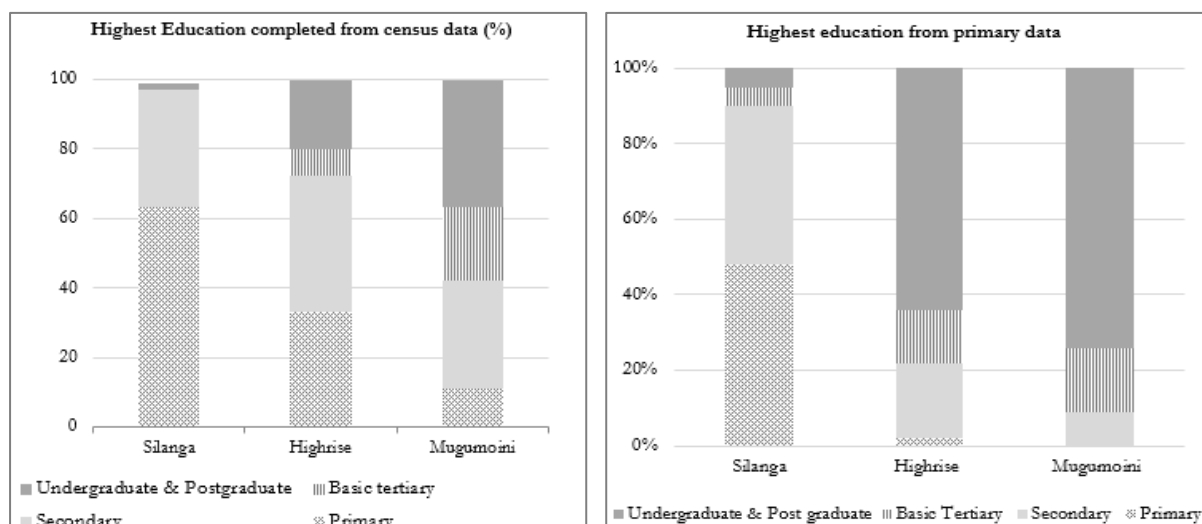
Figure 4-6: Highest education attained in the fragments from KNBS (2009) and household survey (2017)

Employment

Figure 4-7 shows employment status from the three fragments. For this analysis, employment status is divided into formal, informal and economically inactive. The formal employment includes government jobs (local and national), NGO and faith-based organization jobs. Informal employment, on the other hand, include small-scale vendors and street hawkers. The economically inactive are the unemployed, children, students and aged population. Gated community (Mugumoini), has a slightly higher percentage of respondents in formal employment compared to slums and the planned gated. Surprisingly the economic inactive population surpasses the employed (formal and informal) in all the sub-locations (35%). In Nairobi city, unemployment rate ranges between 24% and 40% with higher rates identified in the low-income neighbourhoods especially the slum (Mwaniki, 2017). From the household survey, the majority of respondents in the gated community were employed (82%) while the slum registered the highest percentage of unemployed respondents (48%).
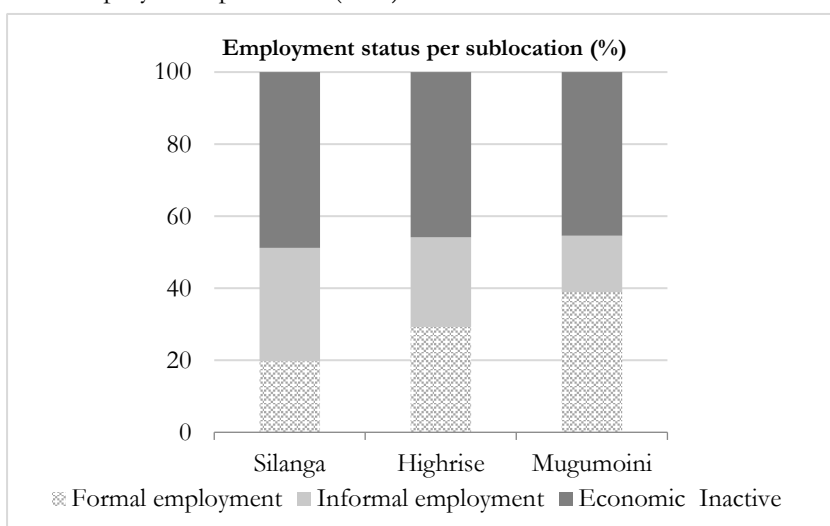
Figure 4-7: Employment status in the three fragments (KNBS, 2009)

Main source of water and main method of sanitation

The analysis in Figure 4-8 shows that the gated community is getting supplied water from City-County through pipes into the dwelling and is supplemented by borehole water. Surprisingly Nyayo Highrise, which is planned non-gated fragment, has a high percentage of households getting water from vendors, which can

be explained by the fact that part of the sub location is a slum. Similarly, on sanitation, Mugumoini is connected to the main sewer, the slum and Nyayo use pit latrine with the formal planned population in Nyayo overshadowed by the slum population.

Most slum dwellers in Nairobi rely on privately owned water supply from pipes at vending points (Mwaniki, 2017). Some other initiatives such as M-Maji and water ATMs (Bendavid & Jeon, 2017; Wesangula, 2016) have been introduced to improve access to water in most of the slums in the city though water affordability remains the main challenge. On average 68% of residents in the slum settlements share toilet facilities with other residents (Parnell & Oldfield, 2014).
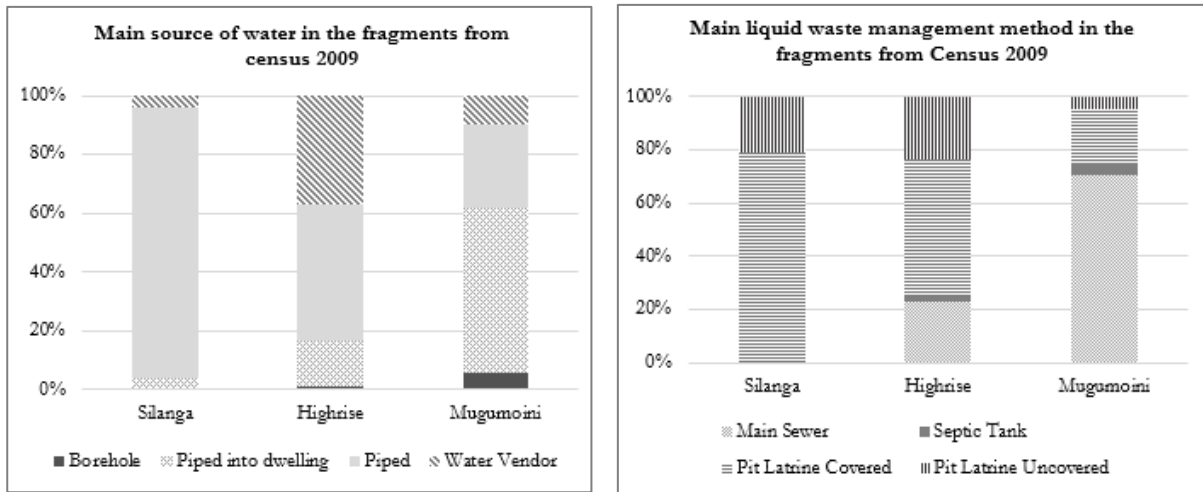
Figure 4-8: Main sources of water and sanitation –KNBS,2009.

4.2.3. Integration in the residential fragments

The measurement of the level of integration aimed to assess residential fragmentation in the three fragments. Symbolic, community and functional integration dimensions were used for the analysis as discussed below:

Symbolic integration

Table 4-2 shows the percentage of residents' responses on symbolic integration based on friendliness, feeling at home, sense of pride and sense of belonging in the three fragments. Comparing the three fragments, the cumulative percentage of respondents that expressed worst feeling on symbolic integration is higher in slums than in the planned non-gated fragment and gated community. For instance, the cumulative percentage of respondents with worst feeling on neighbourhood friendliness in the slum is 27%. However, for the planned non-gated fragment the percentage is 9% and 2% in the gated community. The gated community has majority of respondents with high symbolic integration with no response on very unfriendly, completely not at home, completely not proud and completely not belonging. The sense of pride as a member of the neighbourhood in the slum has the least mean and highest standard deviation in all the four indicators. However, the responses in the gated community have the highest mean scores and lowest standard deviation in all four indicators. Box plots are produced to visualize the mean scores as shown in Appendix 4. From these findings, the results imply that the slum residents felt least integrated compared to the planned non-gated and gated community.

Table 4-2: Percentage of responses on specific indicators of symbolic integration

Friendliness of the neighbourhood		Percentage (%)	Cumulative (%)	**Feeling at home**		Percentage (%)	Cumulative (%)
Slum	Very unfriendly	7	7	Completely not at home	2	2	
	Not friendly	20	27	Not at home	14	16	
	Neutral	11	38	Neutral	16	32	
	Slightly friendly	39	77	Slightly at home	34	66	
	Completely friendly	23	100	Completely at home	34	100	
	Mean	3.50		Mean	3.83		
	Standard deviation	1.24		Standard deviation	1.11		
Non-gated fragment	Very unfriendly	1	1	Completely not at home	1	1	
	Not friendly	8	9	Not at home	8	9	
	Neutral	8	17	Neutral	9	18	
	Slightly friendly	38	55	Slightly at home	34	52	
	Completely friendly	45	100	Completely at home	48	100	
	Mean	4.19		Mean	4.21		
	Standard deviation	0.95		Standard deviation	0.97		
Gated community	Not friendly	2	2	Not at home	2	2	
	Neutral	2	4	Neutral	3	5	
	Slightly friendly	41	45	Slightly at home	45	50	
	Completely friendly	55	100	Completely at home	50	100	
	Mean	4.48		Mean	4.42		
	Standard deviation	0.65		Standard deviation	0.67		

		Feeling sense of pride			**Feeling belonging**		
		Percentage (%)	Cumulative (%)		Percentage (%)	Cumulative (%)	
Slum	Completely not proud	5	5	Completely not belonging	4	4	
	Not proud	29	34	Not belonging	18	22	
	Neutral	17	51	Neutral	14	36	
	Slightly proud	22	73	Belonging	38	74	
	Completely proud	27	100	Completely belonging	26	100	
	Mean	3.38		Mean	3.66		
	Standard deviation	1.29		Standard deviation	1.16		
Non-gated fragment	Completely not proud	1	1	Completely not belonging	2	2	
	Not proud	10	11	Not belonging	10	12	
	Neutral	9	20	Neutral	9	21	
	Slightly proud	43	63	Belonging	38	59	
	Completely proud	37	100	Completely belonging	41	100	
	Mean	4.06		Mean	4.07		
	Standard deviation	0.97		Standard deviation	1.04		
Gated community	Not proud	3	3	Not belonging	2	2	
	Neutral	7	10	Neutral	7	9	
	Slightly proud	41	51	Belonging	41	50	
	Completely proud	49	100	Completely belonging	50	100	
	Mean	4.37		Mean	4.40		
	Standard deviation	0.75		Standard deviation	0.71		

Community integration

To measure community integration, social ties and frequency of contact between friends and family within the neighbourhood and across other neighbourhoods were assessed. Table 4-3 shows a comparison of community integration indicators in the three fragments. What stands out is that gated community on average has lower community integration compared to the slum and planned non-gated fragments evidenced by the mean scores especially on socializing with residents on adjacent neighbourhoods, asking neighbours for help and neighbours asking help. This is also shown on box plots in Appendix 5. Comparing the cumulative percentages, the respondents in the planned non-gated fragment expressed higher integration in all indicators except on interaction within the neighbourhood which the gated community had a highest cumulative percentage of 87%. The cumulative percentage of respondents in the planned non-gated fragment who had good interaction within the neighbourhood is 79%, while the in the slum is 67%.

Table 4-3: Percentage of responses on specific indicators of community integration

		Interaction within the neighbourhood			Socializing with adjacent neighbourhoods		
			Percentage (%)	Cumulative (%)		Percentage (%)	Cumulative (%)
Slum	Bad		1	1	None	2	2
	Not good		8	9	Rarely	12	14
	Fair		24	33	With just a few	40	54
	Good		39	72	Yes most of them	44	98
	Very good		28	100	Yes all of them	2	100
	Mean		3.84		Mean	3.31	
	Standard deviation		0.96		Standard deviation	0.80	
Non-gated fragment	Bad		2	2	None	1	1
	Not good		3	5	Rarely	10	11
	Fair		16	21	With just a few	34	45
	Good		44	65	Yes most of them	52	97
	Very good		35	100	Yes all of them	3	100
	Mean		4.08		Mean	3.46	
	Standard deviation		0.90		Standard deviation	0.75	
	Bad		0	0	None	2	2
Gated community	Not good		3	3	rarely	15	17
	Fair		10	13	with just a few	44	61
	Good		56	69	Yes most of them	39	100
	Very good		31	100	Yes all of them	0	100
	Mean		4.15		Mean	3.19	
	Standard deviation		0.72		Standard deviation	0.77	

		Neighbours asking for help		Asking help from neighbours	
		Percentage (%)	Cumulative (%)	Percentage (%)	Cumulative (%)
Slum	Never	3	3	2	2
	Rarely	15	18	17	19
	Sometimes	28	46	31	50
	Often	39	85	33	83
	Always	15	100	17	100
	Mean	3.48		3.47	
	Standard deviation	1.02		1.03	
Non-gated fragment	Never	5	5	5	5
	Rarely	13	18	11	16
	Sometimes	20	38	26	42
	Often	50	88	45	87
	Always	12	100	13	100
	Mean	3.53		3.52	
	Standard deviation	1.03		1.02	
Gated community	Never	1	1	1	1
	Rarely	25	26	24	25
	Sometimes	39	65	39	64
	Often	29	94	32	96
	Always	6	100	4	100
	Mean	3.15		3.15	
	Standard deviation	0.91		0.87	

Functional integration

The aim of functional integration in this study was to assess access to opportunities and services. Table 4-4 shows the percentage of respondents in all functional integration indicators. On average residents in the planned non-gated fragment, have a relatively low functional integration compared to the other fragments. Cumulating the accessible and very accessible, above 50% of all respondents in the three fragments rated the services accessible. The gated community respondents were 100% integrated on connection to electricity (m=4.57) but least integrated on access to drinking water (30% inaccessible and 54% accessible with a mean of 3.49) contrary to expectation.

Table 4-4: Percentage of responses on functional integration

		Sports facilities	Recreation services	Kindergarten education	Primary education	Health facilities	Electricity connection	Drinking water
		Percentages (%)						
Slum	Very inaccessible	5	1	0	0	0	0	1
	Inaccessible	8	5	3	2	3	5	14
	Neutral	29	22	21	3	4	5	7
	Accessible	26	31	35	56	48	50	49
	Very accessible	32	41	42	39	45	40	29
	Total	100	100	100	100	100	100	100
	Mean	3.74	4.06	4.15	4.33	4.35	4.26	4.06
	Standard deviation	1.13	0.97	0.85	0.62	0.69	0.77	0.79
Planned Non-gated fragment	Very inaccessible	4	1	1	2		0	0
	Inaccessible	21	14	1	27	16	1	4
	Neutral	21	32	4	9	7	2	10
	Accessible	32	33	46	41	42	48	65
	Very accessible	22	20	48	21	35	49	21
	Total	100	100	100	100	100	100	100
	Mean	3.49	3.57	4.39	3.54	3.97	4.45	3.73
	Standard deviation	1.17	0.99	0.71	1.16	1.03	0.59	0.96
Gated community	Very inaccessible	0	2	0	0	0	0	0
	Inaccessible	4	2	1	0	0	0	30
	Neutral	27	12	8	2	2	0	16
	Accessible	27	43	53	63	62	43	52
	Very accessible	42	41	38	35	36	57	2
	Total	100	100	100	100	100	100	100
	Mean	4.06	4.18	4.29	4.32	4.33	4.57	3.26
	Standard deviation	0.93	0.88	0.65	0.51	0.52	0.50	0.92

Table 4-5: Percentages of responses on time used to access the services

	Sports facilities	Recreation facilities	Kindergarten educational facilities	Primary educational facilities	Health facilities
	Percentages of responses				
Slum					
Below 10 minutes	87	87	90	80	78
11-20 minutes	9	6	6	16	12
21-30 minutes	2	5	3	3	7
Above 31 minutes	2	2	1	2	3
Planned non-gated					
Below 10 minutes	69	73	83	46	44
11-20 minutes	18	9	13	14	16
21-30 minutes	9	10	1	24	25
Above 31 minutes	4	8	1	16	15
Gated community					
Below 10 minutes	55	50	55	34	46
11-20 minutes	29	28	32	52	36
21-30 minutes	15	16	13	12	16
Above 31 minutes	1	6	0	2	2

When asked to give time taken to access the services, a high percentage of the respondents walk less than ten minutes to access the services as shown in Table 4-5 below. In the planned non-gated fragment 16% and 15% of the respondents, spend more than 30 minutes to access primary school and health facilities

respectively. This could explain the reason why some respondents report low integration in the planned non-gated especially on primary education and health facilities.

Variability of integration in the three fragments per domain

The coefficients of variation (CV) were computed by dividing standard deviation of each dimension by the mean (Tesfazghi et al., 2010; Turksever & Atalik, 2001) and multiply by 100. Table 4-6 shows the coefficient of variation of the mean of symbolic, community and functional integration as well as an overall integration for each fragment. A small percentage of CV indicate less variability while high CV percentage high variability. From the results, the gated community has low variability across the three dimensions of integration while the slum has high variability except on community integration where planned non-gated fragment shows the highest variability. This indicates that the gated community is homogenous in terms of integration.

Table 4-6: Overall integration between the three fragments

		Slum	Planned non-gated	Gated community
Symbolic integration (SI)	Mean	3.59	4.13	4.41
	Std. Deviation	1.02	0.85	0.59
	Coefficient of Variation (%)	**28.4**	**20.6**	**13.4**
Community integration (CI)	Mean	3.53	3.65	3.41
	Std. Deviation	0.72	0.72	0.64
	Coefficient of Variation (%)	**20.4**	**19.7**	**18.8**
Functional integration (FI)	Mean	4.15	3.93	4.17
	Std. Deviation	0.61	0.64	0.39
	Coefficient of Variation (%)	**14.7**	**16.3**	**9.4**
Overall integration	Mean	3.82	3.90	4.02
	Std. Deviation	0.61	0.53	0.37
	Coefficient of Variation (%)	**16**	**13.7**	**9.2**

From the mean scores, slum and the gated community are highly integrated functionally while the planned non-gated community in moderately integrated (m=3.93). Based on the overall integration mean computed (m=3. 89) in Table 4-7, the slum fragment overall mean (3.82) fall below the overall mean (3.89) hence low integrated compared to planned non-gated fragment and gated community.

Table 4-7: Mean of the 415 respondents

Mean integration (415 respondents)		
Mean	Std. Deviation	Coefficient of Variation-mean Centered
3.89	.553	14.2%

4.3. Quality of life between residential fragments

The aim of this objective was to identify appropriate domains of QoL for data collection and analysis of QoL satisfaction in the three fragments.

4.3.1. Appropriate domains and attributes of QoL in Nairobi

QoL domains are key when assessing perception of people about their life and their connection to the neighbourhoods they reside. One of the goals of key informant interviews was to validate and contextualize the pre-selected domains from the in-depth review of related literature and researchers' prior knowledge and experience in the city. Table 4-8 presents the final domains used for primary data collection after revision. Five domains were identified to be the most relevant for the assessment of QoL in Nairobi.

Table 4-8: Final QoL domains in Nairobi

Domains	Attributes
Physical and built environment	Housing quality in the neighbourhood
	Availability of green spaces within the neighbourhood
	Recreational facilities in the neighbourhood
	Sports facilities within the neighbourhood
	Children playgrounds within the neighbourhood
Public services	Kindergarten school services within the neighbourhood
	Primary schools services within the neighbourhood
	Access to public transport (bus stops) within the neighbourhood
Infrastructure services	Water provision within the neighbourhood
	Electricity connection in the neighbourhood
	Solid waste management in the neighbourhood
Socio-economic	Safety in the neighbourhood
	Relationships with family and friends in the neighbourhood
	Support received from family and friends in the neighbourhoods
	Family income adequacy
Institutional services	City-county provision of public facilities and services in the neighbourhood
	City-county management and maintenance of infrastructure in the neighbourhood

Physical and built environment domain

Access to decent housing is one of the basic human needs and is considered vital for urban QoL (UN-HABITAT, 2010) since it affects perceptions of personal QoL condition (Sirgy, Gao, & Young, 2008). Housing conditions affect peoples' health, their satisfaction with the neighbourhood as well as their economic status. Recreational areas, green spaces, sports and playgrounds help to measure availability, accessibility and quality in the neighbourhoods (Khaef & Zebardast, 2015). Satisfaction with recreation areas helps in personal development in urban through sports, recreations and leisure activities (van Kamp et al., 2003) and indicate quality living conditions within a neighbourhood.

Public and infrastructure service domains

Public and infrastructure services in this study include access to education, water, public transport, electricity and solid waste management. Access to these services impacts individual and community perceptions about their urban QoL (Khaef & Zebardast, 2015). For instance, satisfaction with access to basic education contributes positively to the social domain hence improvement in social life (Sirgy et al., 2008). Good public transportation also influences attitude towards urban QoL regardless of social status. Satisfaction on transportation translates to reliable means to work, recreation, shopping etc. improving QoL condition (Sirgy et al., 2008). In the same way, the higher a coverage and better water and electricity services in the neighbourhoods the higher the QoL condition of the residents.

Socio-economic domain

Residents living in neighbourhoods that are free from crime and safety issues are believed to have better QoL. When people indicate they are satisfied with security it shows they feel safe to walk both during the day and night (Bohnke & Kohler, 2008; Senlier et al., 2008) buying them more time to conduct their daily activities.

Social relations influences integration and cohesiveness in the community hence affect urban QoL. When there are good social relations within the residents, it is believed to improve QoL through social bonding and interactions (Bohnke & Kohler, 2008; Senlier et al., 2008). Satisfaction with social relations enhances the community integration and are very vital for neighbourhood cohesion (Sirgy et al., 2008).

Family income also affects QoL in that families with adequate and satisfied with their income are expected to have better QoL. This dictates the purchasing power standards of the household that the high the income, the high the consumption of goods and services (Bohnke & Kohler, 2008).

Institutional service domain

The institutional domain is important because it affects perception toward the role of authorities in management and provision of services. An inclusive city ensures that all residents are guaranteed a share in the benefits of the urban development (UN-HABITAT, 2010).

4.3.2. QoL satisfaction with domain attributes in the three fragments

Satisfaction with QoL domains in the three fragments is presented here with percentages scores, mean scores and standard deviations. 5 point Likert scale was applied to evaluate the satisfaction were 1 represented very dissatisfied to 5 representing very satisfied. The findings from the analysis of the data are explained below.

Satisfaction with physical and built environment domain attributes

Table 4-9 shows the mean and standard deviation in each built environment attributes. On average, the slum fragment has relatively low QoL satisfaction in this domain compared to the other fragments. In the slum fragment, about half of the respondents felt dissatisfied or worse with housing quality and the majority felt dissatisfied or worst in access to children playground (Figure 4-9). In the planned non-gated fragment, about 40% felt dissatisfied or worse in the availability of green spaces (m=3.17) in the neighbourhood (Figure 4-10). As expected in the gated community, more than half of the respondents were satisfied with all QoL attributes (Figure 4-11).

Table 4-9: Mean scores of built environment domain attributes in the three fragments

		Housing	Green Spaces	Recreational areas	Sports facilities	Children playgrounds
Slum	Mean	3.02	2.60	3.69	3.14	3.12
	Std. Deviation	1.25	0.87	1.08	1.09	1.24
Planned non-gated	Mean	3.76	3.17	3.56	3.20	3.27
	Std. Deviation	1.01	1.15	1.09	1.05	1.08
Gated community	Mean	4.27	3.67	4.24	3.55	3.71
	Std. Deviation	0.68	0.86	0.74	0.84	0.94
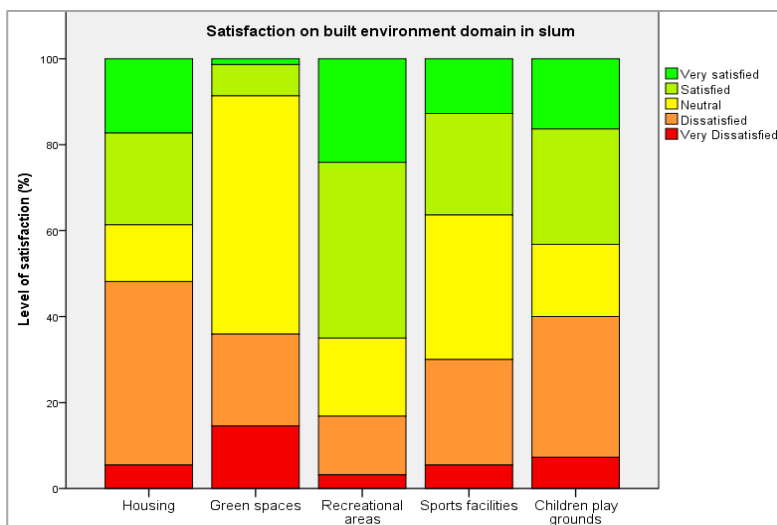
Figure 4-9: Percentage satisfaction with built environment domain attributes in the slum
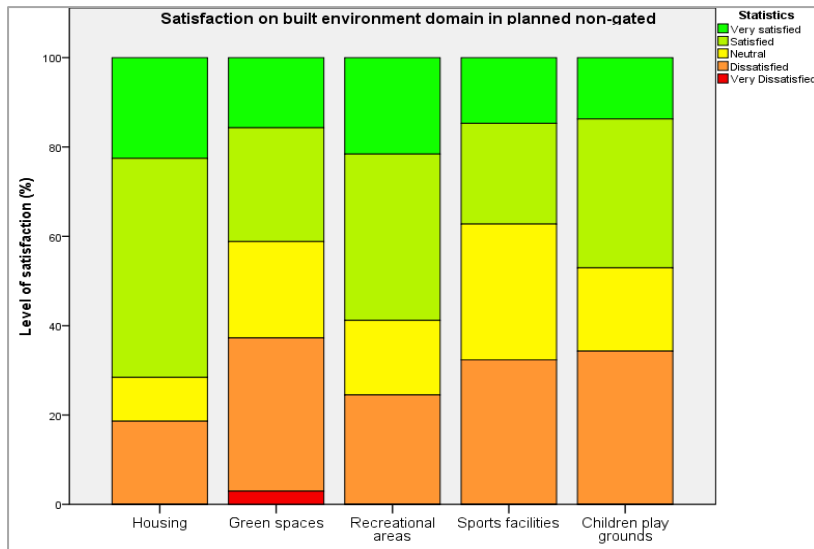
Figure 4-10: Percentage satisfaction with built environment domain attributes in the planned non-gated fragment
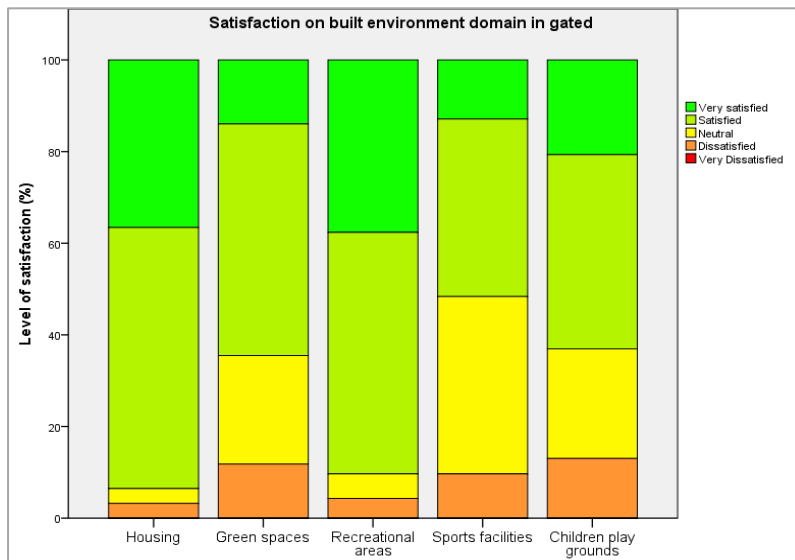
Figure 4-11: Percentage satisfaction with built environment domain attributes in the gated community

Figure 4-12: Neighbourhood with sufficient open and green spaces bordering another with none

Source: Miller (2016)

Figure 4-12 above is an aerial image to show a slum bordering gated community, which is an illustration to explain why the slum respondents felt dissatisfied with green areas within their neighbourhoods.

Satisfaction with public service domain attributes

This domain entailed kindergarten, primary school and public transport services attributes. Figure 4-13 shows percentages of the responses on public services attributes and Table 4-10 shows the mean and standard deviation of each attribute. In respect to the slum fragment, it is worth noting that the responses on this domain were similar to those from the gated community. An unexpectedly high percentage of respondents replied in a positive way in the slum fragment on the public service attributes. Surprisingly, the planned non-gated fragment felt dissatisfied and very dissatisfied with primary school services (49%) with a mean of 2.99. As expected in the gated community, very high percentage of responses were positive in all the five attributes.
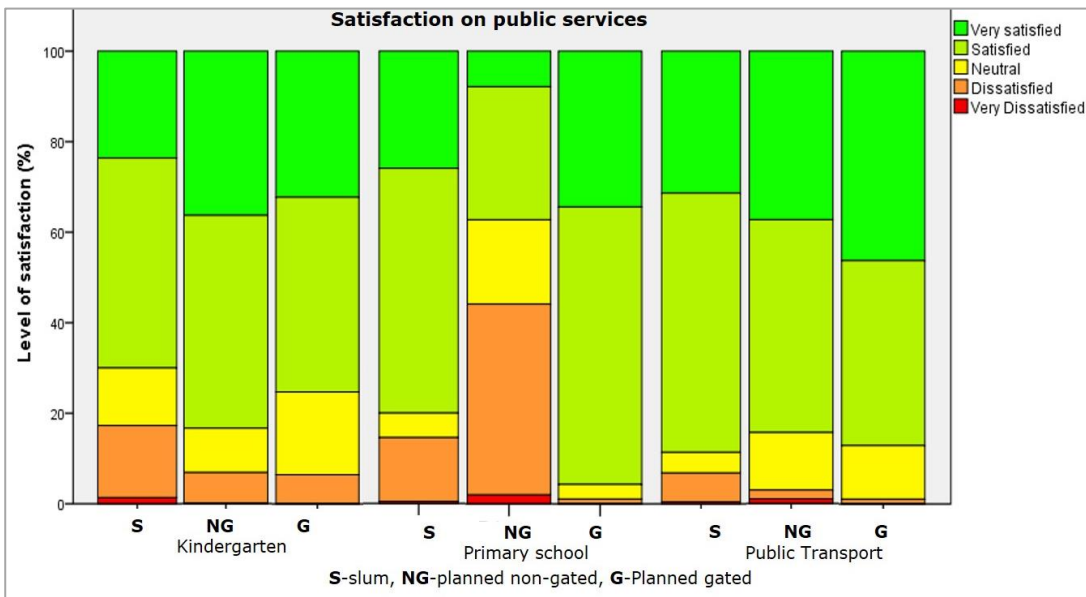
Figure 4-13: Percentage satisfaction with public service domain attributes in the three fragments

Table 4-10: Mean scores of public service domain attributes in the three fragments

		Kindergarten school	Primary school	Public transportation
Slum	Mean	3.75	3.91	4.13
	Std. Deviation	1.03	0.96	0.80
Planned non-gated	Mean	4.13	2.99	4.18
	Std. Deviation	0.85	1.06	0.80
Gated community	Mean	4.01	4.29	4.32
	Std. Deviation	0.88	0.58	0.73

Satisfaction with Infrastructure service domain attributes

Figure 4-14 shows the percentage responses while Table 4-11 shows the mean and standard deviation on infrastructure domain attributes in the three fragments. What is more revealing is that in the slum fragment responses on solid waste management were very negative that the majority of the respondents were very dissatisfied and dissatisfied. An unanticipated high percentage of respondents gave negative responses on access to water in the gated community scoring the lowest mean of 2.67 on this domain (Table 4-11). On electricity services, a high percentage of responses in the gated community and the planned non-gated were positive (satisfied and very satisfied) while in the slum 25% of the respondents were dissatisfied.

Table 4-11: Mean scores of infrastructure domain attributes in the three fragments

		Water provision	Electricity connection	Solid waste management
Slum	Mean	3.66	3.78	2.38
	SD	1.04	1.18	1.22
Planned non-gated	Mean	3.51	4.44	4.23
	SD	1.08	0.59	0.89
Gated community	Mean	2.67	4.49	4.38
	SD	0.94	0.52	0.61
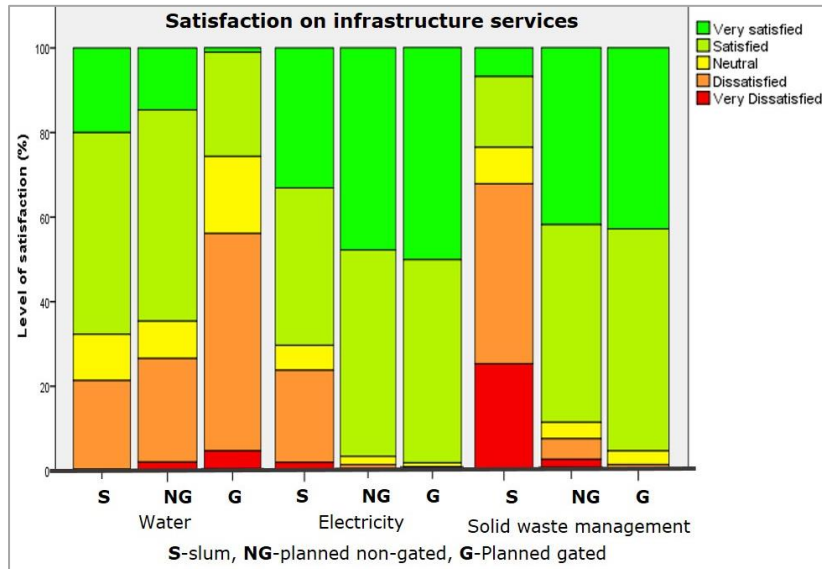
Figure 4-14: Percentage satisfaction with infrastructure domain attributes in the three fragments

Satisfaction with socio-economic domain attributes

This domain entailed safety in the neighbourhood, relationships within the neighbourhood and adequacy of family income. Figure 4-15 reflects on the percentage responses on satisfaction while Table 4-12 shows the mean and standard deviation in the three fragments.
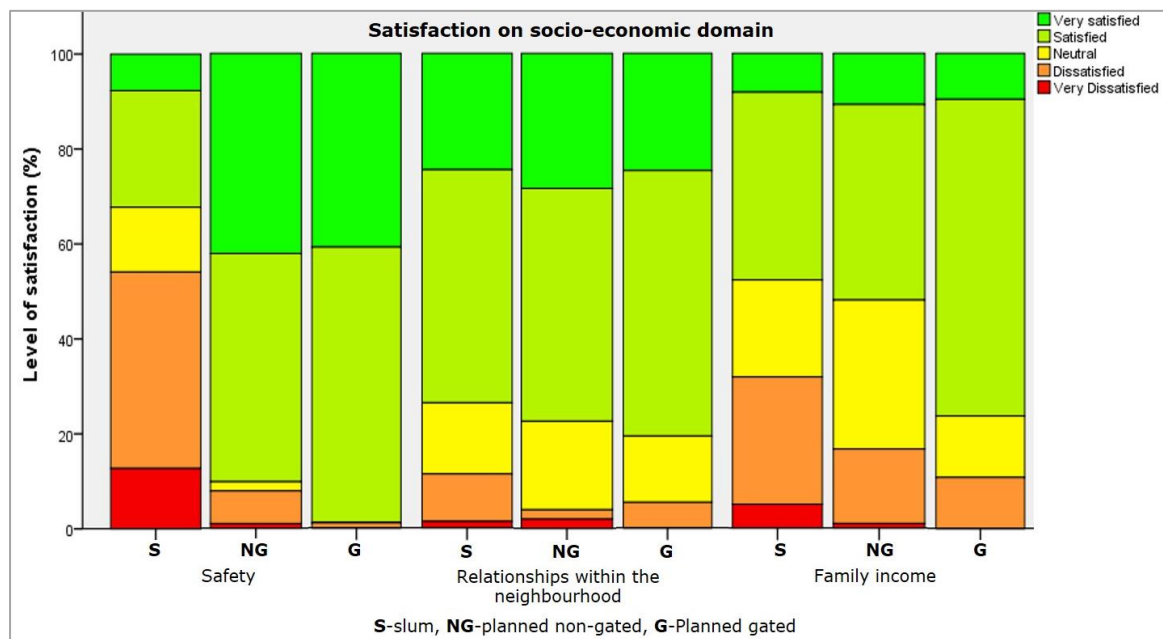
Figure 4-15: Percentage satisfaction with socio-economic domain attributes in the three fragments

More than half of the respondents in the slum answered negatively (very dissatisfied and dissatisfied) on safety scoring the lowest mean of 2.73 in this domain. On the relationship attribute, positive responses (satisfied and very satisfied) were almost similar across the three fragments though the slum mean was lower (m=3.86) than the planned non-gated fragment and gated community. A significant percentage (21%) in the slum neighbourhood were dissatisfied with family income.

Table 4-12: Mean scores of socio-economic domain attributes in the three fragments

		Safety	Relationships in the neighbourhood	Family income
Slum	Mean	2.73	3.86	3.19
	Std. Deviation	1.19	0.95	1.08
Planned non-gated	Mean	4.24	4.00	3.45
	Std. Deviation	0.87	0.86	0.92
Gated community	Mean	4.39	4.00	3.75
	Std. Deviation	0.55	0.78	0.78

Satisfaction with institutional domain attributes

Figure 4-16 and Table 4-13 shows the responses on institutional service domain. The respondents were asked about their satisfaction with the city county's management and maintenance of infrastructural services and provision of public services. The trend in the slum fragment is negative with a high percentage of the respondents indicating they are dissatisfied and very dissatisfied scoring the lowest mean among the three fragments 2.71 and 2.77 respectively (Table 4-13). In the planned non-gated and gated community, the results revealed a high percentage of respondents giving positive answers (satisfied and very satisfied) though 33% in the planned non-gated fragment indicated they were dissatisfied with the provision of public services.
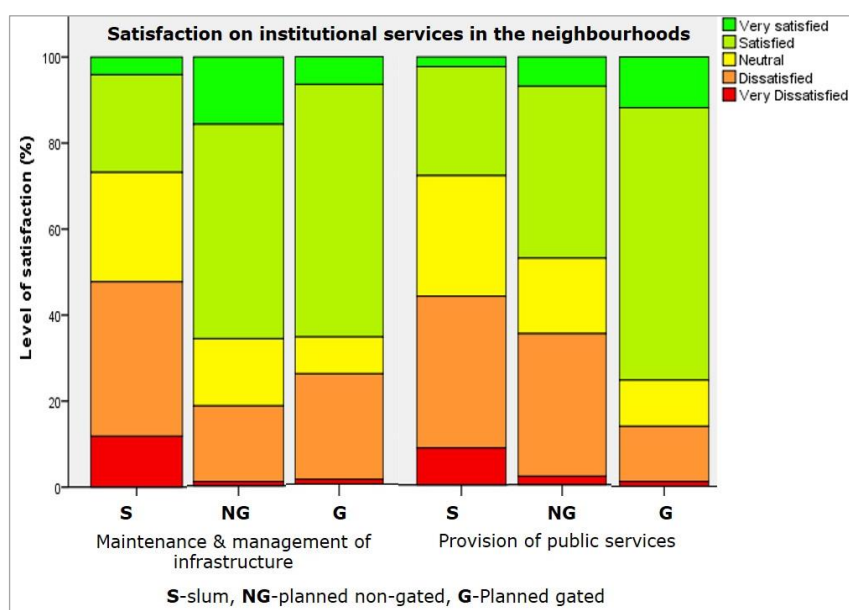
Figure 4-16: Percentage satisfaction with institutional domain attributes in the three fragments

Table 4-13: Mean score of institutional domain attributes in the three fragments

		City-County management and maintenance of infrastructure in the neighbourhood	City-County provision of public facilities and services
Slum	Mean	2.71	2.77
	Std. Deviation	1.07	1.00
Planned non-gated	Mean	3.62	3.17
	Std. Deviation	0.99	1.04
Gated community	Mean	3.45	3.72
	Std. Deviation	0.97	0.88

4.4. Analysis and comparison of quality of life and Integration between residential fragments

This section aims to identify the relationship between QoL domains and integration through correlation of the total responses as well as correlation at fragment level. In the correlation analysis, coefficients ranging from 0.1 to 0.29 represent a weak relationship, 0.3 to 0.49 a moderate relationship and 0.5 to 1 a strong relationship. The correlation helps identify which attributes of QoL domains that are correlated to integration. Coefficients of variation to determine the variability of the QoL domains in each fragment are computed and some of the attributes are then visualized spatially.

4.4.1. Association of quality of life and integration in the residential fragments

Table 4-14: Correlation of integration dimensions and QoL attributes (bold moderate and strong correlations)

QoL attributes	Spearman's rho Correlations	SI	CI	FI
Mean symbolic integration (SI)	Correlation Coefficient	1	.540**	.392**
	Sig. (2-tailed)	.	.000	.000
Mean Community integration (CI)	Correlation Coefficient	.540**	1	.297**
	Sig. (2-tailed)	.000	.	.000
Mean Functional integration (FI)	Correlation Coefficient	.392**	.297**	1
	Sig. (2-tailed)	.000	.000	.
Housing satisfaction	Correlation Coefficient	**.646****	**.304****	**.348****
	Sig. (2-tailed)	.000	.000	.000
Satisfaction with green spaces	Correlation Coefficient	.208**	-.032	.138**
	Sig. (2-tailed)	.000	.519	.005
Recreational areas	Correlation Coefficient	**.344****	.157**	**.500****
	Sig. (2-tailed)	.000	.001	.000
Satisfaction with sports facilities	Correlation Coefficient	.189**	.014	**.336****
	Sig. (2-tailed)	.000	.782	.000
Children play grounds	Correlation Coefficient	.234**	.164**	**.355****
	Sig. (2-tailed)	.000	.001	.000
Kindergarten school facilities	Correlation Coefficient	.266**	.260**	**.440****
	Sig. (2-tailed)	.000	.000	.000
Primary school facilities in the neighbourhood	Correlation Coefficient	.161**	.061	**.489****
	Sig. (2-tailed)	0.001	.217	.000
Public transportation (bus stop) in the neighbourhood	Correlation Coefficient	.224**	.193**	**.388****
	Sig. (2-tailed)	.000	.000	.000
Water provision	Correlation Coefficient	0.094	.202**	.282**
	Sig. (2-tailed)	0.055	.000	.000
Electricity connection	Correlation Coefficient	**.444****	.212**	**.589****
	Sig. (2-tailed)	.000	.000	.000
Solid waste management	Correlation Coefficient	**.456****	.101*	.170**
	Sig. (2-tailed)	.000	.04	.001
Safety	Correlation Coefficient	**.536****	.113*	.277**
	Sig. (2-tailed)	.000	.022	.000
Relationships within the neighbourhood	Correlation Coefficient	**.487****	**.519****	**.397****
	Sig. (2-tailed)	.000	.000	.000
Family income	Correlation Coefficient	**.343****	.203**	.292**
	Sig. (2-tailed)	.000	.000	.000
County management and maintenance of infrastructure	Correlation Coefficient	.190**	.149**	-0.077
	Sig. (2-tailed)	.000	.002	.116
County provision of public services	Correlation Coefficient	.213**	.021	-.003
	Sig. (2-tailed)	.000	.667	.949

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Table 4-14 shows correlation coefficients between the three dimensions of integration and sixteen attributes of QoL using the 415 questionnaires. This matrix is computed to evaluate the statistical significance of each attribute and strength of the relationship. All the attributes of QoL are statistically significant with symbolic integration except water at the confidence interval of 99%. Housing and safety have a strong positive correlation to symbolic integration (0.646 and 0.536 respectively). Primary school services, sports facilities and county management and maintenance of infrastructure have a weak positive correlation (0.161, 0.189 and 0.190) respectively.

Eleven attributes of QoL are correlated to community integration with only housing and relationships within the neighbourhood having moderate and strong positive correlation (0.304 and 0.519 respectively). All attributes of QoL are statistically significant and correlated to functional integration except institutional domain. Recreational areas and connection to electricity indicated strong positive correlation (0.500 and 5.89) with functional integration.

To compute correlation in the three fragments only the moderate and strong correlated QoL attributes from the table 4-14 were used per integration dimension as discussed below:

Correlation of symbolic integration and QoL attributes in the three fragments

Table 4-14 shows the performed correlation of symbolic integration and QoL attributes in the three fragments. Out of the thirteen QoL, attributes eight (8) were correlated to symbolic integration in the slum and non-gated fragment while twelve correlated in the gated community. A strong significant correlation is shown in housing attribute across the three fragments at 99% confidence interval. This indicates that there is a strong association between housing satisfaction and feeling of neighbourhood friendliness, feeling at home, feeling of a sense of pride as well as feeling belonging as a member of the neighbourhood (symbolic integration) across the three fragments.

The matrix shows a strong correlation between relationships within the neighbourhood and symbolic integration in the slum and planned non-gated (0.511 and 0.554 respectively) but moderate correlation in the gated community. This indicates that the more people are satisfied with relationships within their neighbourhoods, the more they feel symbolically integrated.

Infrastructure domain (electricity connection and solid waste management) have a strong significant correlation in the gated community. Electricity contributes to the security in the gated communities, which is the main reason for living in the gated community (UN-HABITAT, 2006a) hence, satisfaction in connection increases symbolic integration. Similarly, effective solid waste management system improves public health, ambience and general aesthetics of the neighbourhood. Many people move to the gated communities to get the services (Mbogo, 2017) hence their strong relation compared to the other fragments. Therefore, an increase of QoL increases symbolic integrations and reduce fragmentation. Safety is strongly correlated in the slum fragment only with a coefficient of 0.512.

Table 4 14: Correlation of symbolic integration and QoL attributes (strong correlations)

QoL attributes	Spearman's rho Correlations	Slum	Planned non-gated	Gated community
Mean SI	Correlation Coefficient	1		
	Sig. (2-tailed)	.		
Housing satisfaction	Correlation Coefficient	**.570****	**.522****	**.537****
	Sig. (2-tailed)	.000	.000	.000
Satisfaction with green spaces	Correlation Coefficient	-.062	.237*	.300**
	Sig. (2-tailed)	.364	.016	.003
Recreational areas	Correlation Coefficient	.289**	.247*	.491**
	Sig. (2-tailed)	.000	.012	.000
Satisfaction with sports facilities	Correlation Coefficient	.051	.354**	.289**
	Sig. (2-tailed)	.453	.000	.005
Children play grounds	Correlation Coefficient	.114	.288**	.345**
	Sig. (2-tailed)	.091	.003	.001
Kindergarten school facilities	Correlation Coefficient	.120	.478**	.272**
	Sig. (2-tailed)	.077	.000	.008
Primary school facilities in the neighbourhood	Correlation Coefficient	.217**	-.013	.423**
	Sig. (2-tailed)	.001	.898	.000
Public transportation (bus stop) in the neighbourhood	Correlation Coefficient	.139*	.175	.461**
	Sig. (2-tailed)	.039	.078	.000
Water provision	Correlation Coefficient	.317**	.115	-.042
	Sig. (2-tailed)	.000	.249	.693
Electricity connection	Correlation Coefficient	.300**	.390**	**.572****
	Sig. (2-tailed)	.000	.000	.000
Solid waste management	Correlation Coefficient	.256**	.303**	**.557****
	Sig. (2-tailed)	.000	.002	.000
Safety	Correlation Coefficient	**.512****	.287**	.406**
	Sig. (2-tailed)	.000	.003	.000
Relationships within the neighbourhood	Correlation Coefficient	**.511****	**.554****	.321**
	Sig. (2-tailed)	.000	.000	.002

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Correlation of community integration and QoL attributes in the three fragments

Community integration creates positive interpersonal connections among the residents in a neighbourhood. Table 4-15 shows a correlation of community integration and QoL attributes in the three fragments. The slum and planned non-gated fragment have a strong positive correlation with relationships within the neighbourhood and community integration hence more interactions in these neighbourhoods improves satisfaction in relationships. Recreation areas encourage interaction among the low-income population (de la Barrera, Reyes-Paecke, Harris, Bascuñán, & Farías, 2016). This may explain why satisfaction with recreational areas is correlated to community integration in the slum only and insignificant in the other fragments. There is a negative moderate correlation between community integration and safety in the gated community such that the more the residents self-segregate themselves in the gated areas the more they feel secure (satisfied with safety) but the less they tend to be integrated in terms of interactions and social networks especially due to the physical barriers.

Table 4-15: Correlation of community integration and QoL attributes (bold strong correlations)

QoL attributes	Spearman's rho Correlations	Slum	Planned non-gated	Gated community
Mean SI	Correlation Coefficient	1		
	Sig. (2-tailed)	.		
Housing satisfaction	Correlation Coefficient	.446**	.316**	-.108
	Sig. (2-tailed)	.000	.001	.302
Recreational areas	Correlation Coefficient	.319**	.079	-.091
	Sig. (2-tailed)	.000	.429	.385
Safety	Correlation Coefficient	.274**	.139	**-.359****
	Sig. (2-tailed)	.000	.163	.000
Relationships within the neighbourhood	Correlation Coefficient	**.576****	**.531****	.334**
	Sig. (2-tailed)	.000	.000	.001
County management and maintenance of infrastructure	Correlation Coefficient	.147*	.024	.311**
	Sig. (2-tailed)	.029	.807	.002

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Correlation of functional integration and QoL attributes in the three fragments

Table 4-16 shows the correlation results of functional integration and QoL attributes across the three fragments. Public service and infrastructure can play a major role in the development of strong policy tool for reducing fragmentation and spatial and social inequalities (MacKillop & Boudreau, 2008). There is a strong positive association between satisfaction with electricity connection and functional integration across the three fragments. Water has a strong positive correlation in the slum neighbourhood only (0.597). The gated community has (6) attributes that are strongly, positive correlated than the slum, and planned gated fragments, which have (4) in each.

Table 4-16: Correlation of functional integration and QoL attributes (bold strong correlations)

QoL attributes	Functional integration			
	Spearman's rho Correlations	Slum	Planned non-gated	Gated community
Mean symbolic integration (SI)	Correlation Coefficient	1	1	1
	Sig. (2-tailed)	.	.	.
Housing satisfaction	Correlation Coefficient	.364**	.424**	.375**
	Sig. (2-tailed)	.000	.000	.000
Satisfaction with green spaces	Correlation Coefficient	-.079	**.541****	.258*
	Sig. (2-tailed)	.246	.000	.013
Recreational areas	Correlation Coefficient	.433**	**.641****	.457**
	Sig. (2-tailed)	.000	.000	.000
Satisfaction with sports facilities	Correlation Coefficient	.276**	.419**	.336**
	Sig. (2-tailed)	.000	.000	.001
Children play grounds	Correlation Coefficient	.216**	**.534****	**.526****
	Sig. (2-tailed)	.001	.000	.000
Kindergarten school facilities	Correlation Coefficient	**.510****	.310**	**.514****
	Sig. (2-tailed)	.000	.002	.000
Primary school facilities in the neighbourhood	Correlation Coefficient	**.555****	.390**	**.507****
	Sig. (2-tailed)	.000	.000	.000
Public transportation (bus stop) in the neighbourhood	Correlation Coefficient	.401**	.211*	**.617****
	Sig. (2-tailed)	.000	.033	.000
Water provision	Correlation Coefficient	**.597****	-.004	-.063
	Sig. (2-tailed)	.000	.967	.553
Electricity connection	Correlation Coefficient	**.662****	**.505****	**.636****
	Sig. (2-tailed)	.000	.000	.000
Solid waste management	Correlation Coefficient	.118	.418**	**.643****
	Sig. (2-tailed)	.082	.000	.000

Safety	Correlation Coefficient	.346**	.435**	.398**
	Sig. (2-tailed)	.000	.000	.000
Relationships within the neighbourhood	Correlation Coefficient	.427**	.357**	.435**
	Sig. (2-tailed)	.000	.000	.000
Family income	Correlation Coefficient	.315**	.280**	.248*
	Sig. (2-tailed)	.000	.004	.017

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

4.4.2.   Variation in quality of life between residential fragments

The coefficients of variation are used to measure variability, homogeneity and consistency of the responses (Tesfazghi et al., 2010) in the fives domains of QoL across the three fragments. In this study, the coefficient of variation is the ratio of standard deviation to the mean expressed in percentage. The analysis was based on the sixteen attributes of the five QoL domains. The fragment with a small percentage of coefficient of variation indicates less variability while the fragment with a high percentage of coefficient of variation shows high variability (Tesfazghi et al., 2010).

Table 4-17 shows the variability of the mean QoL attributes in each fragment. Generally, out of the three fragments the slum fragment has high variability while the gated community has less variability. The gated community is the more consistent compared to the slum and planned non-gated because it recorded the least coefficient of variation percentages in all the attributes except on water (35.1%). The slum, on the other hand, has highest coefficients of variation except on green spaces (33.6%), recreational areas (29.2%) and primary school services (24.5%) which are highest in the planned non-gated fragment and water in the gated community.

Table 4-17: Variability of QoL in the three fragments

| Domain	QOL attribute		Slum	Planned Non-gated	Planned gated
Built environment	Housing	Mean	3.02	3.76	4.27
		Std. Deviation	1.25	1.01	0.68
		Coefficient of Variation (%)	**41.3**	**26.9**	**15.9**
	Green spaces	Mean	2.60	3.17	3.67
		Std. Deviation	0.87	1.15	0.86
		Coefficient of Variation (%)	**33.6**	**36.4**	**23.6**
	Recreational areas	Mean	3.69	3.56	4.24
		Std. Deviation	1.08	1.09	0.74
		Coefficient of Variation (%)	**29.2**	**30.5**	**17.5**
	Sports	Mean	3.14	3.20	3.55
		Std. Deviation	1.09	1.05	0.84
		Coefficient of Variation (%)	**34.9**	**33.0**	**23.7**
	Children playgrounds	Mean	3.12	3.27	3.71
		Std. Deviation	1.24	1.08	0.94
		Coefficient of Variation (%)	**39.6**	**33.1**	**25.5**
Public services	Kindergarten	Mean	3.75	4.13	4.01
		Std. Deviation	1.03	0.85	0.88
		Coefficient of Variation (%)	**27.5**	**20.6**	**21.9**
	Primary school	Mean	3.91	2.99	4.29
		Std. Deviation	0.96	1.06	0.58
		Coefficient of Variation (%)	**24.5**	**35.4**	**13.6**
	Public transportation	Mean	4.13	4.18	4.32
		Std. Deviation	0.80	0.80	0.73
		Coefficient of Variation (%)	**19.4**	**19.2**	**16.8**
Infrastructure	Water	Mean	3.66	3.51	2.67
		Std. Deviation	1.04	1.08	0.94
		Coefficient of Variation (%)	**28.3**	**30.7**	**35.1**
	Electricity	Mean	3.78	4.44	4.50
		Std. Deviation	1.18	0.59	0.52
		Coefficient of Variation (%)	**31.1**	**13.3**	**11.7**
	Solid waste	Mean	2.38	4.23	4.38
		Std. Deviation	1.22	0.89	0.61
		Coefficient of Variation (%)	**51.3**	**21.0**	**13.9**
Socio-economic	Safety	Mean	2.73	4.24	4.39
		Std. Deviation	1.19	0.87	0.55
		Coefficient of Variation (%)	**43.5**	**20.5**	**12.6**
	Relationships	Mean	3.86	4.00	4.00
		Std. Deviation	0.95	0.86	0.78
		Coefficient of Variation (%)	**24.6**	**21.4**	**19.5**
	Income	Mean	3.19	3.45	3.75
		Std. Deviation	1.08	0.92	0.78
		Coefficient of Variation (%)	**33.7**	**26.6**	**20.7**
Institutional	Management and maintenance of infrastructure	Mean	2.71	3.62	3.45
		Std. Deviation	1.07	0.99	0.97
		Coefficient of Variation (%)	**39.4**	**27.2**	**28.2**
	Provision of services	Mean	2.77	3.17	3.72
		Std. Deviation	1.00	1.04	0.88
		Coefficient of Variation (%)	**36.0**	**32.7**	**23.6**

Spatial variation of quality of life

To visualize the spatial variation of the QoL, five attributes that showed the coefficient of variation percentages that are more varied across the three fragments were selected. These were housing (built environment), primary school services (public services), solid waste management system, water (infrastructure) and safety (socio-economic). Since five Likert scale was used in the study whereby 1 represented very dissatisfied and 5 very satisfied, this was reclassified into 3 whereby respondents falling within 1 and 2 were classified into dissatisfied, 3 neutral while 4 and 5 were classified into satisfied. Good QoL is evidenced more in the gated community compared to planned non-gated and slum neighbourhoods.

Satisfaction with housing

Figure 4-17 a and b presents the spatial variation of the responses in the three fragments. The housing attribute involved asking the respondents how satisfied they were with the quality of housing in their neighbourhood. The findings revealed that residents in the planned non-gated fragment and gated community gated community were satisfied with housing. The residents in these two fragments felt that the houses in their neighbourhoods were in good condition, permanent and spacious. One of the respondents in the gated community said, *"The type of the houses here are modern, spacious, have good design and secure"-a resident of the gated community*. Similarly, one of the respondents in the planned non-gated reported, *"Our houses are well constructed, in good condition and better quality than the neighbourhood across"-a resident in the planned non-gated fragment* pointing at the slum area.

In the slum neighbourhood, variation of responses are noticeable although the majority respondents were dissatisfied. Some of the reasons they gave were little space for living, leaking roofs, poor living conditions, flooding during rainy season and lack of power connection. The respondents who were satisfied despite the poor quality of the housing and poor living condition reported that the houses are affordable, they have no other option and since all the houses in the slum have similar characteristics, it makes them satisfied with the condition.
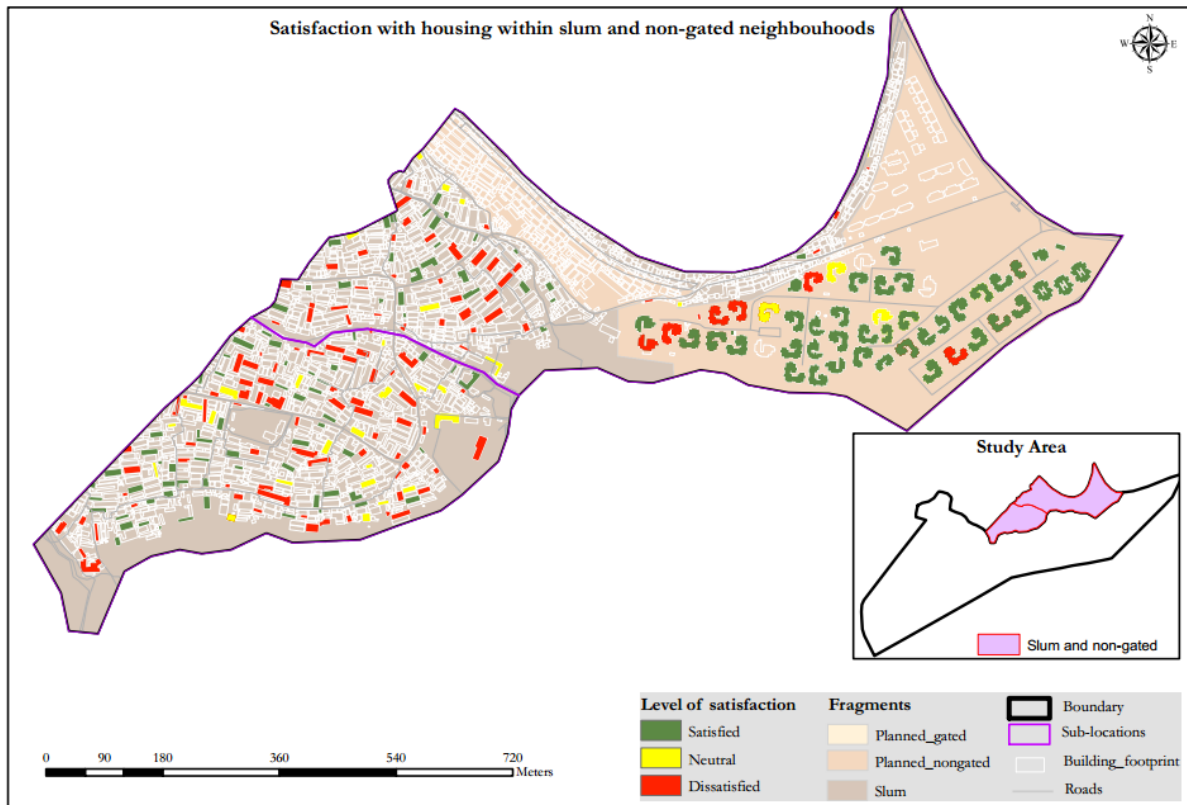
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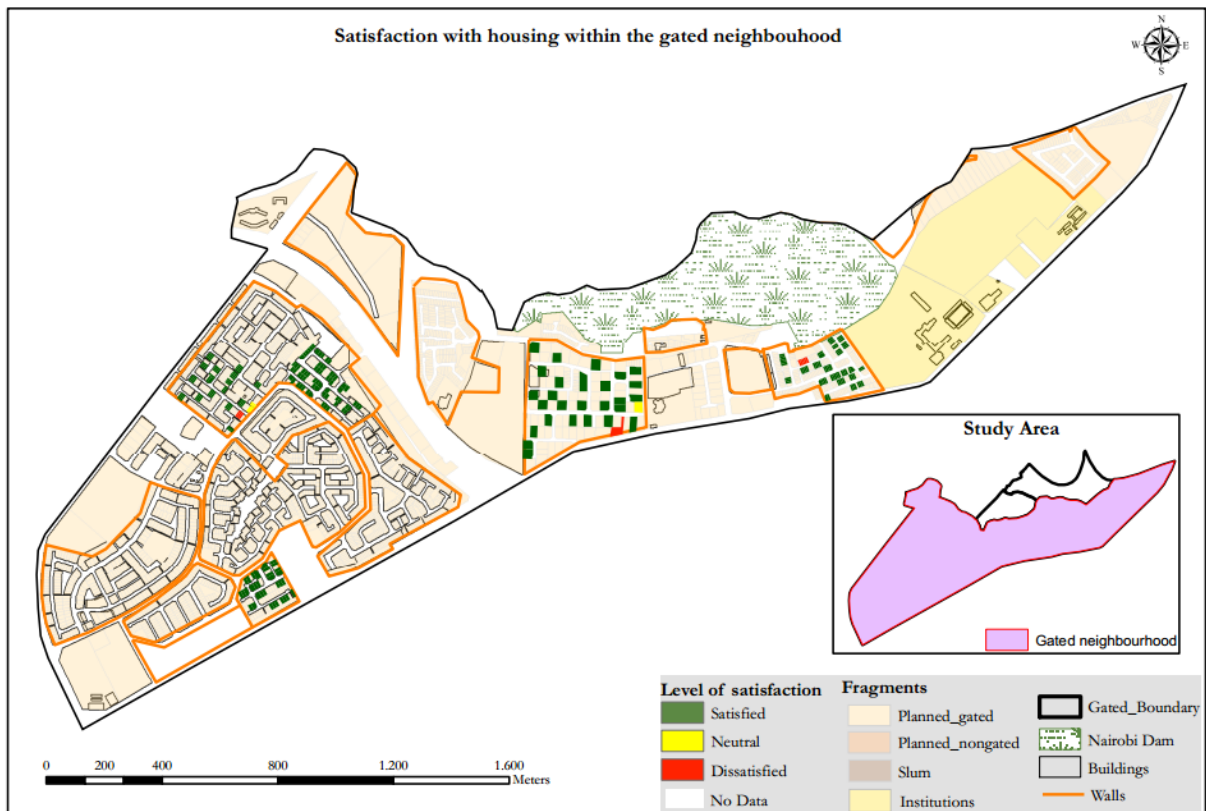
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Figure 4-17: Residents satisfaction with housing in the three fragments

Satisfaction with primary school service

Primary education is acknowledged as a basic human need and is used as an estimate to measure social advancement and economic performance (UN-HABITAT, 2004). Some of the policies for reducing the social inequality gap between the poor and the well-off promote education which improves skills of the deprived individuals. In the Global South, poor neighbourhoods and slums are associated with high illiteracy levels and poor education services (Mwaniki, 2017) while gated communities are associated with educated people and good public services available for the residents.

Figure 4-18 a and b show the variation of responses on access to primary school services in the three fragments. The respondents in the gated community were positive (satisfied) with primary school services while there is mixed spatial variation in the slum and the planned non-gated fragments. In the planned non-gated the majority of the respondents were dissatisfied with primary school services in the area because their children have to travel long distances to access the facilities. Only one facility is available in the neighbourhood, which has only lower primary classes. One reported, "*No upper primary in the area and the child have to travel to go to school. I have to take them to Langata*"-a respondent in the planned non-gated fragment.

In the slum fragment, most households located near the education facilities seemed satisfied owing it to the proximity to the schools. However, the dissatisfied respondents in the slum even with education facilities near argued that the services were very expensive; most of them are private and crowded hence congestion in the existing facilities.

The gated community respondents indicated that the primary school services in the neighbourhood are affordable, closely located to the residential, with good teachers and classes not congested or crowded.
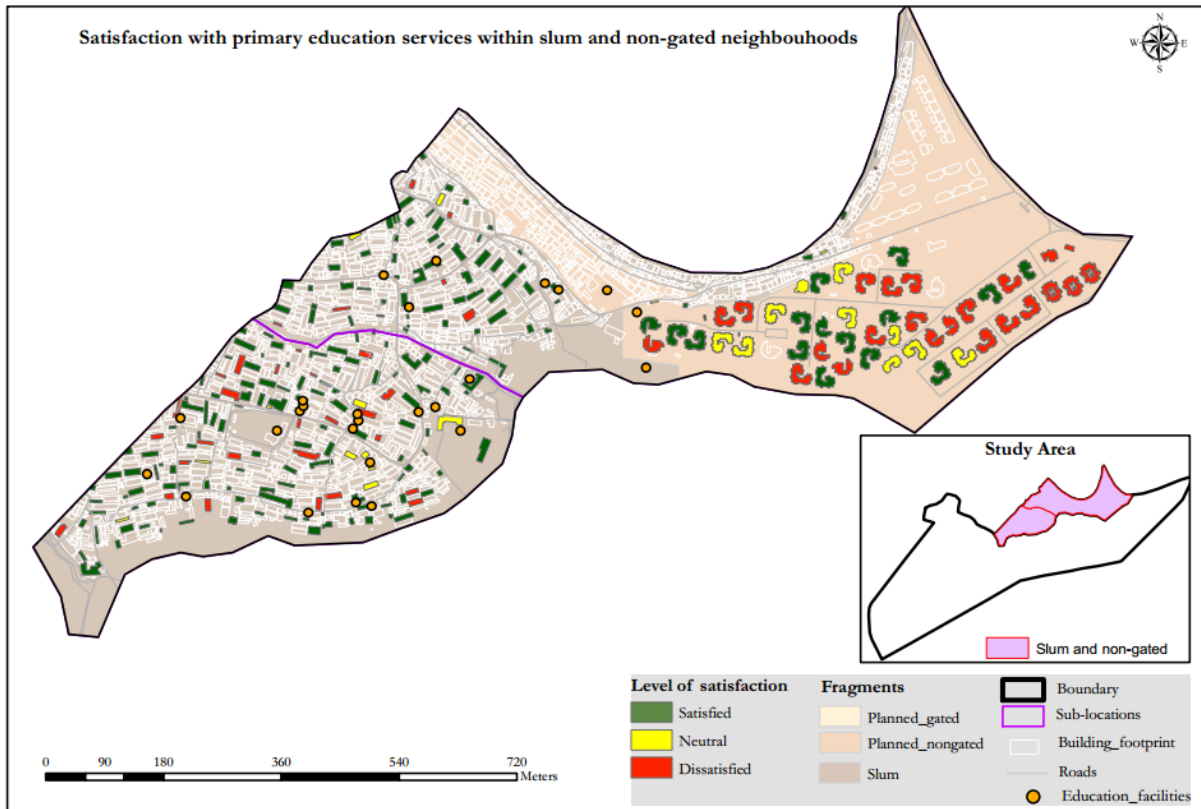
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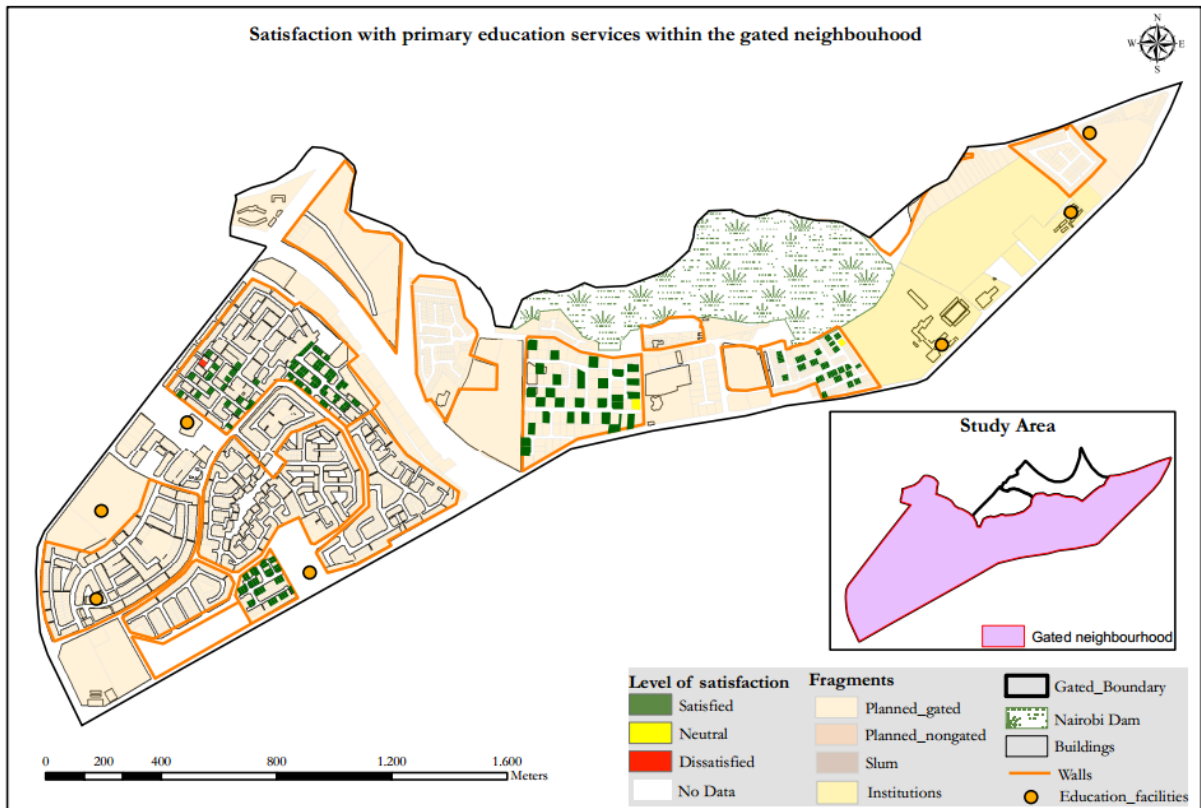
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Figure 4-18: Residents satisfaction with accessibility to primary school services in the three fragments

Satisfaction with solid waste management

Although solid waste management is poor in Kenya, it is worse in the city of Nairobi resulting in many residents turning to private service providers (Mwaniki, 2017). It is even worse in the slum areas, which has no solid waste management system at all contributing to environmental problems and poor public health. The lack of solid waste disposal in the slums leads to negative attitudes that contribute to the degradation of a sense of community (Mutisya & Yarime, 2011).

Figure 4-19 a and b show the variation of responses on solid waste management in the three fragments. Although there are some variations on the responses in the slum, a high percentage were dissatisfied. Some households that are located near roads and main footpaths were satisfied because along these roads, the youth in the community provides the services by transporting the waste to the nearby rivers and the open spaces as some argued, "*the youth have made it easier to manage waste in the neighbourhood by collecting weekly*"- *a respondent in the slum*. Those dissatisfied complained of dumping of waste everywhere in the neighbourhood some indicating that "a *lot of waste is thrown just near my house since its close to the river*", "*we don't have a structured waste system*" and "*our waste management system isn't good but we are used to it*". The areas not accessible by cart do not receive these services hence more dissatisfied.

No spatial variation on the responses in the gated community and the planned non-gated fragments. The respondents are satisfied. Some of the explanations for their satisfaction are,

> "*Waste collection is done by private companies and done every twice a week*", "*Waste is collected by contracted companies at an affordable fee*"-*respondents in the gated community* and "*There is a garbage collection program which has ensured proper management of solid waste*"-*a respondent in the planned non-gated fragment.*
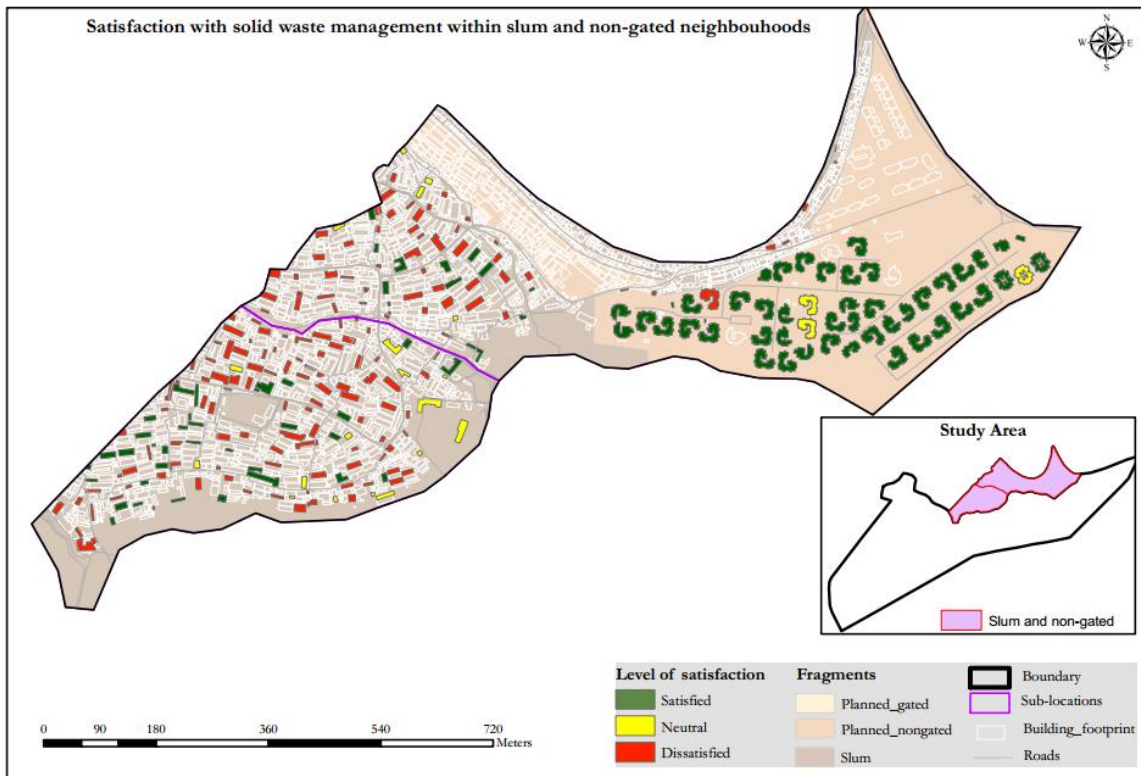
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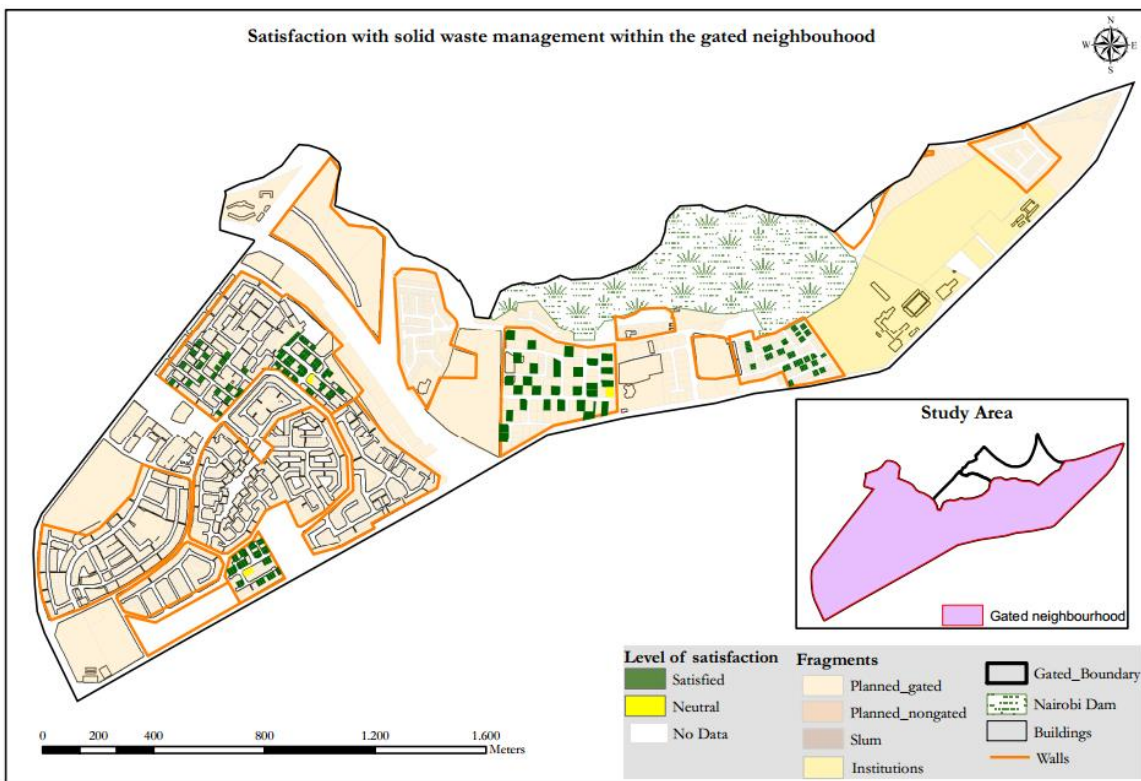
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Figure 4-19: Residents satisfaction with solid waste management services in the three fragments

Satisfaction with water

Access to adequate clean water for drinking is one of a major milestone to achieve a sustainable and inclusive city in the Global South countries. However, the city of Nairobi over the last year (since January 2017) has experienced major water shortage and rationing affecting both the well-off and the slum residential areas (Daily Nation, 2017; Koech, 2017; Otieno, 2017; Watson, 2017). This has been due to a decreased level of the main water reservoir for Nairobi city in Ndakaini Dam. This has led to the residents that depend on water from the city-county receiving the water services twice or thrice a week as opposed to the daily supply. The inconsistencies in the water services force the residences to turn to other sources such as water kiosks, handcarts, tankers and private boreholes with different water quality and prices (Mwaniki, 2017).

Figure 4-20 a and b show the spatial variation of the satisfaction with water services. It is worth noting that an unanticipated high percentage of negative responses are revealed in the gated community that scored the highest variability (Table 4-17) compared to the slum and the planned non-gated. The satisfied respondents in the gated community stated they had borehole that serves as an alternative source while the dissatisfied residents stated that their only alternative source of water is water tankers that are expensive. The gated community and planned non-gated consume an average of 200-300 litres of water per day per capita (lpcd) against 15 lpcd in the slum (Mwaniki, 2017) which explain the dissonance of the residents in the gated community since they have to spend more money buying from tankers. In the slum areas, various alternative initiatives now exist such as M-Maji and Water ATMs hence may explain their the residents' satisfaction.
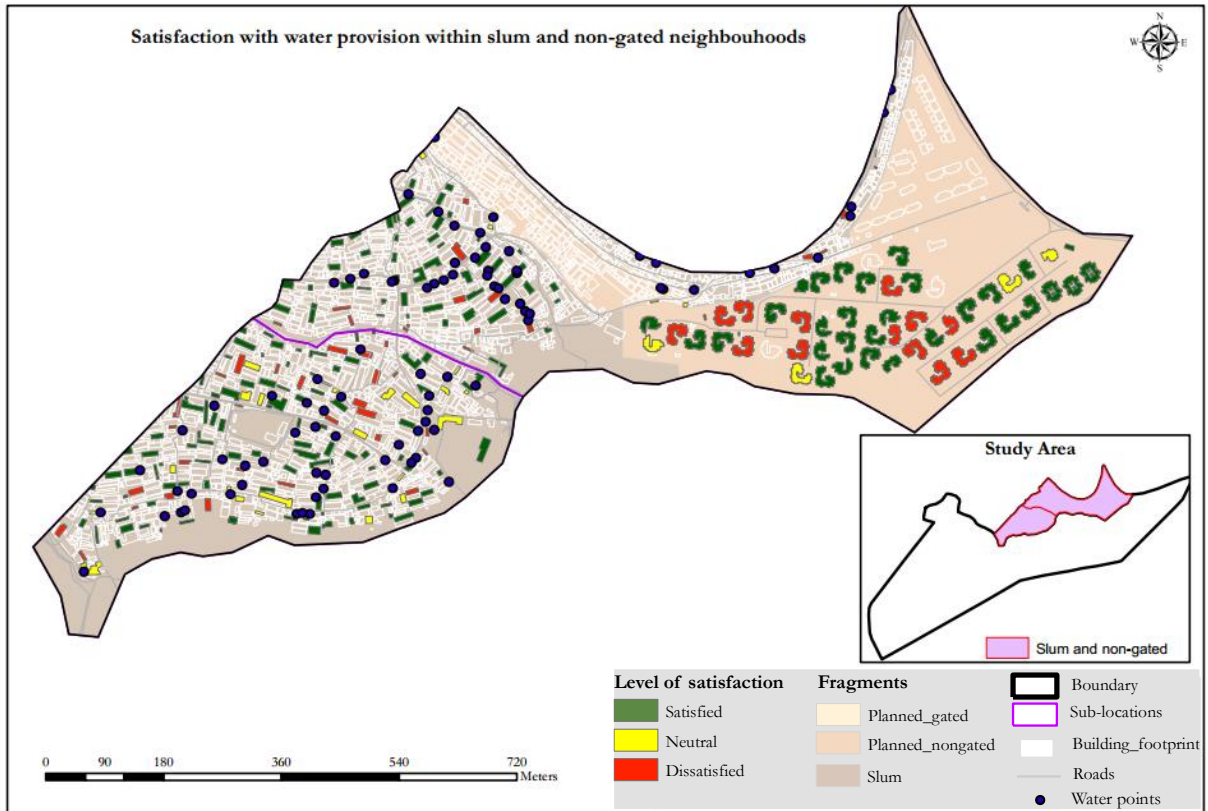
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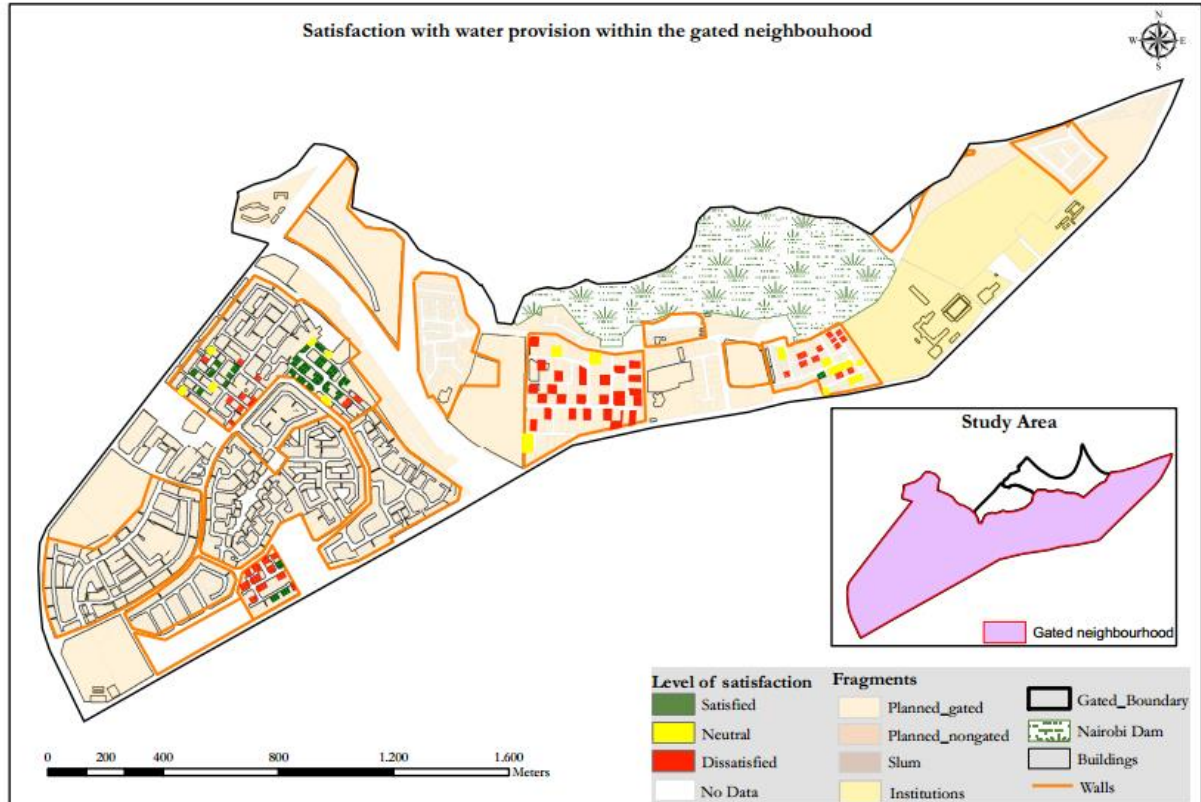
b) Figure 4-20: Residents satisfaction with water provision services in the three fragments

Satisfaction with safety

Physical environment and social environment are some of the elements believed to contribute to fear of crime in urban areas (Abdullah et al., 2012). Insecurity and crimes are major hindrances of inclusive development in most of the Global South cities and a major contributor to the proliferation of gated communities, especially in Nairobi. The slum fragment has several areas marked as crime hot-spots (Map Kibera, 2018).

Figure 4-21 a and b show the spatial responses on the satisfaction with safety in the fragments. The responses in the gated community and non-gated fragment shows homogeneous responses while the slum fragment show variation on the responses. A high percentage of respondents in the slum is dissatisfied with safety especially in areas near crime hotspots (figure 4-21a). Some of the identified reasons behind the dissatisfaction in the slum are that the neighbourhood lack street lighting hence very insecure at night. Majority of the respondents argued that the area is very insecure at night that leads to loss of lives. This situation has resulted in the development of barriers within the slums such that about 40-60 households have a common entrance (gate) with the informal arrangement of opening and closing hours to protect themselves from crime.

The respondents in the gated community are satisfied with safety by reporting that the neighbourhood has good security service and gates. One stated, "*This is a gated community with proper security officers who monitor everyone who enters*" *a respondent in the gated community*. Similarly, residents in the planned non-gated fragment reported that there are no cases of insecurity in the neighbourhood and the neighbourhood is even secure at night.

Other spatial variations in satisfaction with QoL attributes including relationships within the neighbourhood, family income and City County's management and maintenance of infrastructure are presented in Appendix 6.
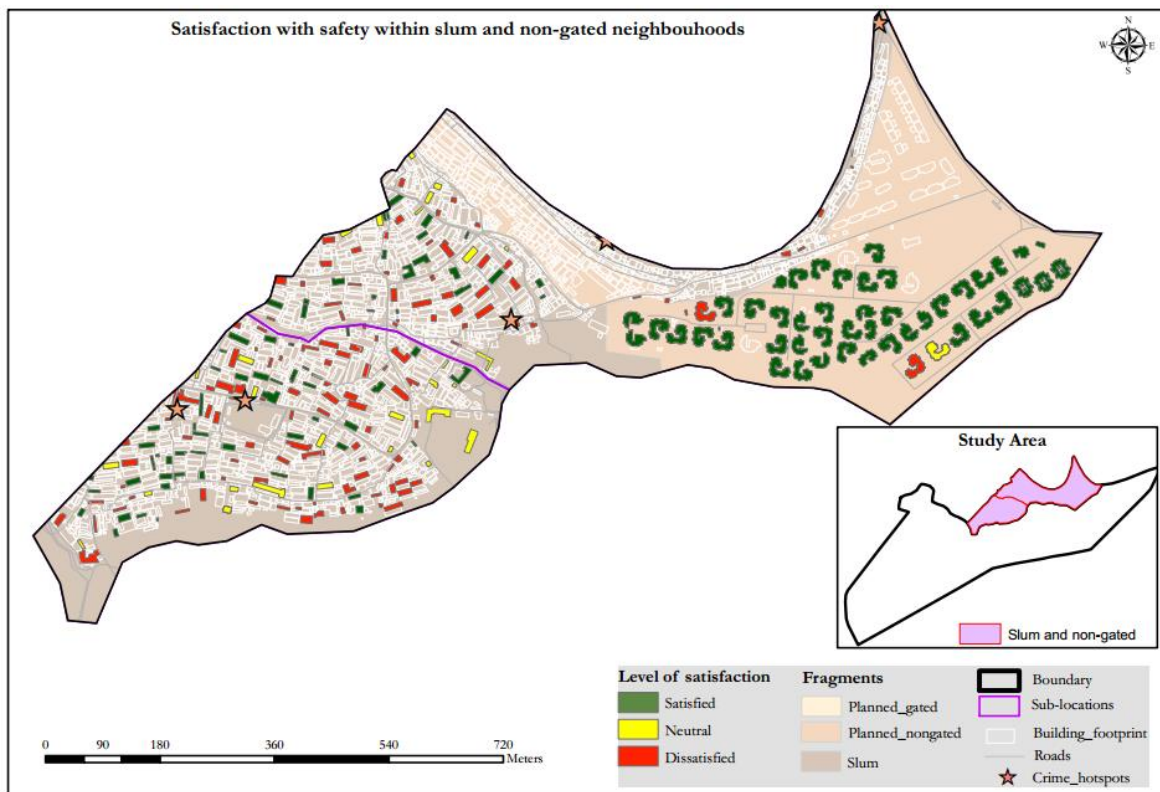
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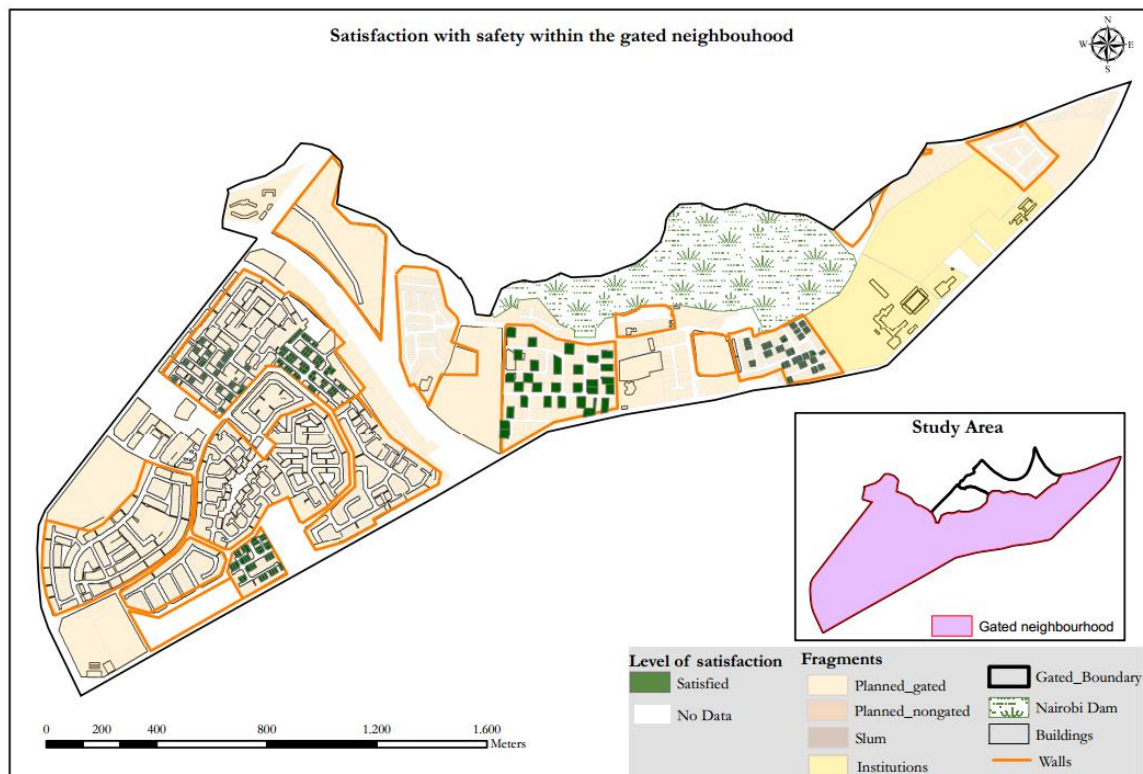
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Figure 4-21: Residents satisfaction with safety in the three fragments

4.4.3. Quality of life satisfaction between integrated and disintegrated respondents

An independent t-test of the overall mean integration and QoL domain and attributes was computed (Appendix 7 and Appendix 8). This test was to compare the mean score of QoL between two groups of respondents; respondents with high overall integration and respondents with low overall integration. The mean QoL satisfaction of respondents with high integration is higher than the mean QoL satisfaction of respondents with low integration, using domains of QoL and attributes of QOL. All the results were significant at 95% confidence interval. Generally, the respondents who felt highly integrated are also satisfied with their QoL both at domain and attribute, hence the QoL perception of people who feel integrated differ significantly with the QoL perception of people who feel less integrated.

5. DISCUSSION

This chapter presents the interpretation of the study findings based on the set objectives.

5.1. Prevailing residential patterns, planning and drivers of residential fragmentation Nairobi

This study sought to understand residential patterns and drivers of fragmentation in the city of Nairobi. Nairobi appears to be greatly fragmented with sudden changes in urban forms and mosaic of distinct fragments. The spatial differences are reflected in zoning regulations of residential neighbourhoods especially on the type of houses allowed in neighbourhoods, size of the houses, plot ratio and plot coverages, which further echoes the social classes. Physical structures such as walls, fences, roads, rivers etc. present clear-cut separation lines between different urban sections. Just like in Delhi and Cape Town (Dupont & Houssay-Holzschuch, 2005), the enforced principles introduced by the colonial rulers introduced residential dissimilarity whereby buffer zones were dividing European space and natives. Today, such buffers together with walls, fences and gates divide the rich and the poor in the neighbourhoods.

The spatial patterns evidenced in the city agree with the argument by Balbo and Navez-Bouchanine (1995) that cities in the Global South are made up of distinct planned and unplanned fragments. Nairobi has attempted to develop urban policies and plans that aim to promote orderly spaces and getting rid of informal settlements. However, despite the efforts since 1948 Nairobi master plan, no much difference is noticeable especially on the low-income neighbourhoods but the city has continued to grow in fragmented manner. Most of the plans prepared target the middle and upper-class residents and neglect the poor and low-class residents who make up the majority in the city. The previous plans developed were in top-down models that did not involve the low-income communities; these are criticized by Watson (2009) for their contribution to fragmentation and social-spatial inequalities in the Global South cities that continue to exist. Most of these plans remain only on papers (Mwaniki, Wamuchiru, Mwau, & Opiyo, 2015; Watson, 2013).

Apart from the initial partitioning of the city from colonial period, today the city depicts a mixture of informal and illegal city as described by Balbo and Navez-Bouchanine (1995). It has characteristic of dualism (O'Connor, 2013) with formal and informal developments and the dissimilarity between the well-off and the deprived neighbourhoods. Planning and zoning of residential areas is based on economic status hence influencing and perpetuating the current patterns. Public housing provision dwindled after independence providing an opportunity for private sector to deliver housing who favoured the high and middle-class population due to high returns. This increased the development of informal settlements mostly occupied by the low-income population. The rigid planning standards in the city have denied majority of the residents the access to adequate housing which is a constitutional right.

Housing developments have taken place without responsive development framework especially in the low-income areas (K'Akumu & Olima, 2007; Mwaniki et al., 2015) resulting in planned and unplanned residential patterns. Several plans and programmes have existed for development such as Nairobi Urban Study Group-1973-2000 (Owuor & Mbatia, 2008), Nairobi City Commission Development Plan 1984-1988, The Nairobi We Want Convention in 1993 and Nairobi Metro 2030 in 2008. However, the benefits of these plans are yet to be realized. They ended up being shelved and not implemented. The city thus continues to face many problems of service delivery (water, sanitation, solid waste collection and security) and housing shortage. The private sector is the main housing provider in the country, however; it is biased on meeting high demand of housing for middle and high-income population further contributing to the residential fragmentation.

As discussed in section 3.2 and 4.1 of this report, the spatial organization of residential areas in the city has been marked by a chain of factors. Such factors include the history of the city from colonial city to post independence, the impact of land use planning (zoning), policies and contemporary issues like the proliferation of gated communities due to increased insecurity. These factors contribute to the residential patterns in Nairobi city space as well as influencing the socio-economic structuring of the people living in the different fragments and distribution of public facilities like schools, provision of water.

The results on the drivers of fragmentation agree with the findings in Latin American cities (Caldeira, 2000; Coy, 2006) and South African cities (Landman, 2004; Landman & Badenhorst, 2012) that gated communities contributes greatly to fragmentation especially due to insecurities. Gated communities in Nairobi, just like in other cities as explained in section 2.1.1 reflect closed residential areas that limit interaction and affect integration within the neighbourhoods. However, unlike other cities, insecurity issues in the city of Nairobi has resulted in different perspectives of gating in the residential fragments. Gating is not only meant for the wealthy in Nairobi but also the low-income population is gating their residential areas. This has redefined the fragmentation into a new level such that there are islands of fragments within fragmented neighbourhoods. This shift has worsened fragmentation by limiting inter and intra neighbourhood accessibility through blockage of footpaths and access roads thus compromising integration. The current proliferation of gated communities, continue to propel the fragmentation leading to the growth of informal settlements with the city having over 130 slums distributed across it (Ngau, 1995).

5.2. Characteristic of the residential fragments

Residential developments in the city of Nairobi can be grouped into three categories namely gated communities, planned non-gated fragment and slums. In addition to these distinct fragments, fragmentation of services and infrastructure are evident with the gated community enjoying well-designed neighbourhoods (see Table 4-1), proper services (Figure 4-8) and exclusiveness from the rest of the city. The gated community (Mugumoni) residents enjoy proximity to shopping malls (e.g. Langata shopping mall,), a variety of protected leisure activity venues in the vicinity and wide roads of access as well as green spaces (Figure 4-5b) characteristics found in gated communities of Latin American Cities (Borsdorf & Hidalgo, 2010). The middle and upper-income population are the residents in these neighbourhoods and most of the services are privatized. The planned non-gated areas also enjoy minimum standard services provided by the City-County that are sometimes not well managed and maintained such as water and sanitation utilities. Residents' dream in planned non-gated fragments is to live gated community hence people live in these neighbourhoods as they save money to join the gated class since most residents in the planned non-gated fragment (Nyayo Highrise) are fresh graduates who have joined job markets.

On the other extreme of the planned fragments are the slums that host the largest portion of the city residents (60%) having primary and secondary school level of education. This translates to the low income they get and the high unemployment rate. The residents in the slums have no other options but survive in very deplorable housing conditions, inadequate and expensive water services, lack of green spaces and leisure venues as well as lack of physical soft infrastructure e.g. waste disposal system.

The residential classification in Nairobi shows multidimensional inequalities in physical and social space which is parallel with findings and classification in Dar es Salaam in Tanzania by Babatunde (2015). Although Nairobi's fragmentation and spatial patterns may have similar inceptions of the colonial system, like other cities in the world such as Cape Town in South Africa, Delhi in India (Dupont & Houssay-Holzschuch, 2005), its effects is different. For Nairobi case, the effects of the colonial and post-colonial housing development reveal historical injustices to the poor with no attempt to provide basic minimum standards in their residences. Table 3-1 gives a general view of the residential characteristics of residential categories in Nairobi. It shows distinction of residential neighbourhoods in the city of Nairobi. These residential

typologies contribute to the fragmentation experienced in the city. It is worth noting that planned non-gated and the slums are informally fencing themselves (with different degrees of access control) which also exacerbate the spatial fragmentation within the neighbourhoods.

5.3.   Integration in the fragments

The findings in this study show different integration responses in the different fragments. Study by Sabatini and Salcedo (2007) concluded that spatial patterns benefits the poor and integrates them to the society symbolically and functionally. The invasion of gated communities into the poor peripheries in the city of Chile provided services and casual jobs to the poor income neighbourhoods. However, Nairobi has a different situation whereby there are no major invasions of gated communities to the poor peripheries but mostly some of the poor and the low-income neighbourhoods attach themselves to the developed planned neighbourhoods (Karisa, 2011) especially when there is vacant public land. The findings on the three dimensions of integration are discussed below:

5.3.1.   Symbolic integration

From the findings, the slum residents felt least integrated symbolically giving reasons like poor living conditions, insecurity and poor public services (Table 4-2, Table 4-6 and Appendix 4). One stated, *"This is a bad neighbourhood for upbringing children, I hate the place not safe and people are not friendly"- a respondent in the slum.* On the other hand, the residents in the gated community felt highly integrated, completely proud as members and completely belonging because the neighbourhood is safe, has good aesthetic values and good environment for children to play. One stated, *"I am completely proud as a member of this neighbourhood because of the positive perception the area has from outsiders"-a respondent in the gated community.* These findings agree with the results by Muiga and Rukwaro (2016) in the city of Nairobi that found out that physical boundaries in the gated community instil sense of belonging since the residents are able to control their own residential space. In addition, the gates, walls and enclosures in the gated communities provide a powerful feeling of symbolic integration for the residents of the gated communities and create sense of togetherness (Landman, 2000; Shawish, 2015).

However study in the city of Chile (Sabatini & Salcedo, 2007) revealed that arrival of gated communities created a sense of pride among the poor to desire to make their homes better. This contradicts the findings in Nairobi since many of the residents living in the slums have no option hence forced to coexist with the well-off. This coexistence may not improve their sense of pride but tend to increase their feeling of stigmatization and marginalization as some reported. Prior studies have shown that coexistence of the extreme neighbourhoods makes it hard for the marginalized to recognize opportunities to develop their social prestige making social mobility hard to achieve (Morgan, 2013).

5.3.2.   Community integration

Community integration provides a level of connectivity, relations, social networks cohesiveness and inclusiveness but the differing distribution of welfare, shared values and social rules causes differences in community integration (UNRISD, 1994). In this study, the findings show that the gated community residents have a relative low community integration evidenced by low mean scores compared to the other fragments (Table 4-3 and Appendix 5). This finding is aligned with the findings by Sabatini and Salcedo (2007) where community integration performed poorly among the gated community residents. Physical barriers and spatial layouts in the gated communities tend to isolate people from each other, create a barrier to social interaction and prevent development of social networks as reported in the literature (Blakely & Snyder, 1997; Jacobs, 1961; Landman & Schonteich, 2002; Legeby, 2010; Low, 2001).

One of the key informants stated, "*In the gated communities you'll find people are contained in their boundaries, the walls they've built. They hardly interact. When people come from their houses, they get into their cars and the next thing is they're out*"-*key informant 1*. A study by Landman (2000) had similar findings and sentiments.

5.3.3. Functional integration

One of the ways in which socio-spatial integration can be measured is through the degree of accessibility of public services available to all urban residents (Ruiz-Tagle, 2013). Functional integration refers to the ease of access to opportunities and facilities that exist within cities (Landman, 2006). The results revealed that the gated community and the slum areas were relatively highly integrated compared to the planned non-gated (*Table 4-4 and Table 4-6*). This agrees with the findings by Sabatini and Salcedo (2007) whereby the gated communities benefit the slum by bringing services such as electricity, water and roads. In Nairobi, it is the same case only that the slum residents sometimes illegally self-connect themselves leading to loss of up to 40% of utilities meant for planned areas (Karisa, 2011). Key informant 3 stated, "*There is some interaction, in terms of the casual job services the slum people offer to the adjacent gated settlements. And that's why it's also difficult to move them out there*". The high integration in the slums can also be related to the community-based initiatives, NGO and Faith-based organization programs that aid in providing services such as health, education and water. High percentage of respondents in the slum (77%) and the gated community (88%) indicated that they access education, health and recreation services within their neighbourhoods.

The respondents in the planned non-gated fragment, however, are least integrated with 50% accessing education, health and recreation services in the adjacent neighbourhoods. Access to community resources such as recreational areas, sports facilities, kindergarten and primary schools foster a sense of place and sense of belonging (Witten et al., 2003) which in turn promotes functional integration.

5.4. Quality of life in the residential fragments

Human needs vary from one group to another and from city to another; hence domains of QoL of life should reflect the local specific context and goals intended to meet. Based on this, experienced researchers and planners in the city were involved to ensure the QoL domains were locally relevant. Five domains of QOL identified from literature (Table 2-1) were modified to make them locally relevant as shown in the final list in Table 4-8. This entailed five QoL domains namely built and physical environment, public services, infrastructure, socio-economic and institutional domain. The five domains had sixteen attributes used to develop questions for the QoL assessment in the household survey.

5.4.1. Physical and built environment domain

In the gated community high percentage of the respondents were satisfied with built and physical environment domain owing it to adequate planning that provided all necessary standards required for the built form. On contrary, majority of the respondents in the slum fragment were dissatisfied especially with housing and children playgrounds (Figure 4-9). This align with the findings in Rosalio (Martinez, 2016) which argued that insufficient and shortage of housing and housing needs are more evident in deprived neighbourhoods compared to well-off neighbourhoods. In addition, the developments in the slums have no particular orientation and design leaving no space designated for children playgrounds. Recreational areas are only available within public primary and secondary schools. In the planned non-gated fragment, high percentage of respondents were dissatisfied and very dissatisfied with green spaces (*Figure 4-10).* This could be attributed to the poor planning of the non-gated fragments that do not provide for all the requisite land uses such as open space, children playgrounds. Findings by Berkoz (2009) revealed that green spaces, open spaces, children playgrounds are significant for built environment satisfaction in non-gated residential areas.

5.4.2. Public services domain

On the public service domain, all the fragments were satisfied with public services except the planned non-gated community residents who were dissatisfied with primary school services (*Figure 4-13*). The main reason identified for the satisfaction was the availability of many facilities within walking distance in the gated and slum neighbourhoods. The reason identified for dissatisfaction in the non-gated fragment is that there is no upper primary school in the neighbourhood; hence, the residents have to travel to other neighbourhoods for primary school services making it expensive. This agrees with the findings on non-gated neighbourhoods in Istanbul (Berkoz, 2009) that revealed that accessibility to education institutions is one of the key factors that affect non-gated areas.

5.4.3. Infrastructure service domain

The most outstanding finding is the dissonance in water in the gated community where the majority of the residents were dissatisfied with water provision (Figure 4-14). This is dissonance state of QoL since the gated fragment has the highest percentage of households connected to piped water into the dwelling (Figure 4-8a). Even though the fragment has a high percentage of households connected to piped water into the dwelling, high percentage of respondents were dissatisfied because of frequent water rationing such that the water only runs twice or thrice a week. Thus, the residents have to seek an alternative source of water hence incur more expenses. The situation was found to be worse in the estates where there are no boreholes to supplement this supply.

Concerning solid waste disposal, a high percentage of respondents in the slum area felt dissatisfied (Figure 4-14). They complained that solid waste heaps are all over the neighbourhood and has contaminated the rivers and degraded the open spaces within the neighbourhood. This is because of no proper waste management system. A small group of youth in the community collects some of the waste from the households, dumps them in the nearby rivers, and open spaces. This agrees with the argument by Mutisya and Yarime (2011) that slums in Kibera lack proper solid waste management facilities. However, the satisfaction on solid waste management in the gated is aligned with findings by Muiga and Rukwaro (2016) revealing that the majority of the residents in the gated communities in Nairobi get improved private services (e.g. garbage collection) hence their satisfaction.

5.4.4. Socio-economic domain

Concerning socio-economic domain, the majority of the residents in the gated and non-gated community were satisfied (*Figure 4-15*). However, the slum fragment residents felt dissatisfied with safety. The main reasons identified were that the neighbourhood is very insecure during the night; some streets are very narrow leading to high crime rates that are evidenced by daytime mugging and life of fear. High crime rates are reported in Kibera slums (Muiga & Rukwaro, 2016). This situation has made the residents create an adaptation method of constructing gates to prevent throughways within their quarters and agreed on informal opening and closing hours. On the other hand, gated community respondents were very satisfied with safety giving reasons that the neighbourhood is walled, gated and secure from crime incidences which agrees with literature (Caldeira, 2000; Landman, 2000; Rodgers, 2004).

5.4.5. Institutional service domain

The slum fragment residents felt dissatisfied with the institutional service domain compared to the gated and non-gated community residents (*Figure 4-16*). The main reasons identified for their dissatisfaction are that there is poor management of solid waste, lack floodlights and poor roads. On the provision of services, the residents complained that the city-county has done little in the provision of sewer, streetlights and solid waste management. However, in the gated community and non-gated fragment, the respondents' reasons for satisfaction were that there well-maintained roads, regular garbage collection and working streetlights. This is just as Muiga and Rukwaro (2016) argued that the gated community enjoy better and privatized

services such as security services, solid waste management and infrastructure among others, the findings in this study showed the same in all QoL attributes except the water services. Residing in slum allows the government to abdicate their responsibility of providing public and infrastructural services.

Table 5-1 shows overall satisfaction per domain presenting the mean, standard deviation and coefficients of variation. Variability is computed at fragment level. The results reveal high CV in the slum fragment and low CV in the gated community. Tesfazghi et al. (2010) argued that on variability that suggested that mean QoL scores are negatively related to the coefficient of variation hence the higher QoL the less the CV. The gated community has higher QoL and less CV hence agreeing with the findings by Tesfazghi et al. (2010). This, therefore, indicates that the gated community that is relatively homogeneous while the slum and planned non-gated fragments with relatively low QoL are heterogeneous in terms of QOL satisfaction.

Table 5-1: Variability of quality of life domains in the three fragments

Domain		Slum (n=220)	Planned non-gated (n=102)	Gated community(n=93)
Built environment	Mean	3.11	3.39	3.89
	Std. Deviation	0.67	0.78	0.53
	Coefficient of variation (%)	**21.6**	**23**	**13.6**
Public services	Mean	3.93	3.77	4.21
	Std. Deviation	0.71	0.56	0.59
	Coefficient of variation (%)	**17.9**	**15.5**	**14**
Infrastructure	Mean	3.27	4.06	3.85
	Std. Deviation	0.82	0.63	0.38
	Coefficient of variation (%)	**25.1**	**15.5**	**9.9**
Socio-economic	Mean	3.41	3.92	4.02
	Std. Deviation	0.70	0.60	0.43
	Coefficient of variation (%)	**20.7**	**15.3**	**10.6**
Institutional	Mean	2.74	3.39	3.59
	Std. Deviation	0.86	0.89	0.72
	Coefficient of variation (%)	**31.4**	**26.1**	**20**
Overall QoL	Mean	3.28	3.68	3.93
	Std. Deviation	0.52	0.48	0.34
	Coefficient of variation (%)	**15.8**	**13**	**8.6**

5.5. Comparing QoL between residential fragments

5.5.1. Association of quality of life and integration in the residential fragments

Studies to quantify association of residential fragmentation and QoL are noticeably absent in the literature. Hence, one of the questions in this study was to explore correlations of QoL domains and integration indicators. The findings show that housing has strong positive correlation with symbolic integration across the three fragments that suggests that the higher the satisfaction with housing, the higher the mean score of symbolic integration. This relates to the findings by Sabatini and Salcedo (2007) that people feel sense of pride if the areas that they are living look better. This may therefore explain the reason most of the slum respondents felt least integrated symbolically (Table 4-2) as well as dissatisfied with housing (Figure 4-9). There is a strong significant and positive correlation between infrastructure (e.g. electricity connection and solid waste management) and symbolic integration in the gated community. According to K'Akumu and Olima (2007); Olima (2001) people choose to live in gated communities due to the good infrastructural services provided hence the higher the satisfaction with infrastructure, the higher the mean of symbolic integration in the gated community.

Safety and relationships in the neighbourhoods are significantly positively correlated with the symbolic integration across the three fragments. However, they have a strong correlation (+0.512 and +0.500) in the slum hence the higher the satisfaction with safety and relationships the higher the residents tend to feel symbolically integrated. These findings may suggest that slum and non-gated community are more concerned with the built environment (housing) and socio-economic domains (relationships and safety) to

feel symbolically integrated. On the other hand, the gated is more concerned with built environment (housing) and infrastructure services (electricity and solid waste management) to feel symbolically integrated.

In the slum and the non-gated fragments, relationships within the neighbourhood are significantly and strongly positively correlated with the community integration compared to the moderate correlation in the gated community. It is worth noting that safety has a negative correlation with community integration in the gated community. This may suggest that the more people are satisfied with safety in the gated communities, the low the mean of community integration. It agrees with the findings in the several studies (Caldeira, 2000; Landman, 2000, 2004; Ozkan & Kozaman, 2006) that gated communities make the residents feel secure but the physical boundaries, barriers and gates limit and reduce social networks and integration (Blakely & Snyder, 1997; Jacobs, 1961; Landman, 2002; Morgan, 2013; Ozkan & Kozaman, 2006).

Findings on the functional integration show positive results with many QoL attributes having strong and significant correlations. However, with regard to the slum fragment, it is worth noting that there exists a strong positive correlation between water and the functional integration but no correlation in gated and planned non-gated. This suggests that residents are dissatisfied with water in the slum and feel functionally disintegrated. Green spaces are strongly significantly correlated with functional integration (+0.541) only in the planned non-gated fragment hence the higher the satisfaction with green spaces, thus the higher the mean of functional integration. Green spaces are not significant to functional integration in the slum or gated communities.

5.5.2. Variation in QoL between residential fragments

The units of analysis "classified as fragments' for variability in this study represent the smallest administrative (sub location) and lowest census units released to the public in Kenya. The findings revealed clear variation between the three fragments using coefficients of variation hence the fragments are not homogenous. High satisfaction mean of QoL are evidenced in the gated community with low CV, which may imply that the gated community is relatively homogeneous in terms of QOL while the slum is relatively heterogeneous in terms of QoL satisfaction. The spatial variation using QoL attributes also revealed these variations with gated community scoring high QoL in most of the attributes except on the water. In the slum area, residents leaving near crime hot spot areas were dissatisfied with safety.

5.5.3. Does fragmentation affect QoL

An independent t-test was used to compare the mean of QoL between the highly integrated and low integrated residents. The results show that there is a significant difference between the mean score of respondents who feel integrated and the respondents feeling disintegrated hence the significant difference between the two groups.

In addition, the findings of this study show that fragmentation is related to QoL conditions. This is evidenced by the differing QoL conditions identified in the three fragments with slum scoring the lowest in overall QoL as well as the lowest in the overall integration assessment. It relates to the study by Dear and Flusty (2002) arguing that the negative consequences of gated communities that contribute to fragmentation in the cities are exclusion and social inequalities reflected on the patterns of residential fragments. As spatial inequality increases, social inequality increases to an equivalent degree as well as residential fragmentation (ibid).The separation and closing of neighbourhoods of the same status and class tend to worsen perception of marginalized residents (Morgan, 2013).

It is also clear that gating limits community integration in the neighbourhoods. Physical designs such as creating territorial spaces, closing or gating streets, building fences and walls, improving appearance, and personalizing the environment could reduce the fear of crime and increase the feeling of safety (Blakely &

Snyder, 1997) but increase community disintegration. de Jeude, Schutte and Quesada (2016) also argued that fragmentation is an image of social segregation within society.

Although (Sabatini & Salcedo, 2007) claimed that gated communities benefit the low-income neighbourhoods and slums, in Kenya the relationship is in two-fold. There are benefits and costs. From the perspective of gated community, slums provide (cheap) labour as gardeners, housekeeping and security guards. From the perspective of the slum, which is classified as an illegal settlement, provision of services (e.g. water and electricity) are not availed. The residents hence connect themselves illegally from the gated community services which lead to inconveniences and extreme pressure on the existing utilities leading to diversion of up to 40% of services meant for planned neighbourhoods (Karisa, 2011). The seemingly interdependent growth in the neighbourhoods conceals the intense divides between the wealthy suburbs of the city of Nairobi and marginalized groups living in urban slums with differing quality of life and access to basic services. Residential fragments increase social exclusion making it harder for the poor to become part of the city.

6. CONCLUSION AND RECOMMENDATIONS

The aim of this study was to analyse and explain the association between residential fragmentation and quality of life case study of the city of Nairobi, Kenya. The study-involved analysis of three residential fragments (sub locations) in the Kibera division categorized into slum, planned non-gated and gated community.

6.1. The relationship between residential fragmentation and Quality of Life in Nairobi

History and the planning in the city of Nairobi are key aspects in understanding the prevailing patterns of residential developments. The historical aspect of the city dates back to its inception and its first master plan *(the settler city plan)* in 1948 which was developed partitioning and dividing the city based on racial lines with zones of the Europeans (British settlers), Asians and Africans. After independence, socio-economic classes replaced the racial partitioning of the city where high-income, educated and successful Africans occupied the European zones, the middle-income population occupied the Asian zones and the African zones by the low-income population. To date residential zoning in the city is based on economic status. The existing plans in Nairobi favour the middle and high-income residents excluding the poor and leading to dissimilarity in residential development hence this has made the city to grow in a skewed manner. Although the city is recognized to have a rapidly growing economy and is placed first in East and central Africa, a keen study of its spatial, economic and social structure reveals its dual nature of formal and informal residential fragments. Insecurity greatly contributes to proliferation of gated community that exacerbate the situation of residential fragmentation. Lack of social welfare system to provide low-income housing leads to marginalization of the poor since private sector provide housing for the middle and high-income residents reflecting the current state of well-planned and unplanned residential neighbourhoods. These are the major drivers of residential fragmentation in Nairobi.

The residential neighbourhood were categorized into slum, planned non-gated and gated for this study. The study revealed that the gated community occupies the highest percentage of residential land (84%) compared to slum (5%) and planned non-gated (11%) (see section 4.2). The fragments also showed differing characteristics in terms of settlement pattern, main available services and socio-economic characteristic of the residents with gated community residents enjoying well-planned and designed neighbourhoods and sufficient services. The planned non-gated residents enjoy basic minimum standard of living but the slum residents living in extremely deplorable conditions especially housing and solid waste management (see section 5.2). However, the narrative that gating of the neighbourhoods is for only the wealthy has taken another paradigm shift in the city of Nairobi. The planned non-gated and the unplanned (slums) residents are informally fencing themselves (with different degrees of access control) which also exacerbate the spatial fragmentation within the neighbourhoods. This is largely contributed by insecurity experienced in the city that gating has become a requirement of each neighbourhood. However, in the slums since the residences cannot afford to pay for guards, they apply instrumental rationality on security whereby they agree to put a gate and specify a time for opening and closing the gates (see section 4.12 and 5.2).

The results on the level of integration show that the slum residents felt the least integrated compared to the planned non-gated fragment and gated community. However, residents in the gated community have lower community integration compared to the other fragments. The gated community residents felt highly integrated functionally compared to the slum and the planned non-gated fragments (see section 4.2.3).

Five domains of QoL and sixteen attributes were identified from the literature were modified during key informant interviews to fit the local context of Nairobi city. The final domains include physical and built

environment, public services, infrastructure services, socio-economic and institutional services (see section 4.3.1). The analysis of QoL satisfaction revealed that the gated community have higher QoL satisfaction compared to other types of residential fragments. Variability of the QoL in the fragments was determined using the coefficient of variation. The gated community has low coefficients of variation compared to the slum and the planned non-gated fragments indicating it is relatively homogenous while the slum is relatively heterogeneous in terms of QoL (see section 4.4.2 and 5.4.2).

There is a strong positive correlation between symbolic integration and QoL domains related to the built environment (housing +0.646) and socio-economic domain (safety +0.536) indicating that people who are satisfied with housing also perceive their neighbourhood to be friendly, have a sense of pride and feel belonging. Community integration strongly correlated positively with relationships within the neighbourhood (+0.519) indicating that residents who have satisfaction on their relationship within the neighbourhood tend to have good social networks and interactions. Infrastructure domain (e.g. electricity attribute) is significantly positively correlated with functional integration (+0.589) implying that residents satisfied with connection to electricity are likely to perceive their accessibility to services in the neighbourhood positively hence integrated functionally (section 4.4.1). Comparing the QoL mean scores between two groups of respondents; respondents with high overall integration and respondents with low overall integration revealed that there is a significant difference between the two group QoL means (see section 4.4.3). Therefore, people who have higher QoL satisfaction also have a higher mean score of integration hence less fragmented.

The findings, show that residential fragmentation undermines integration and development of inclusive city. This is because fragmentation physically excludes some urban dwellers through walling, fencing and use of barriers limiting interaction and integration. Studies shows that many cities, especially in the Global South, are experiencing spatial fragmentation issues associated with increasing inequalities, social exclusion, and proliferation of gated communities (Watson, 2009). This results in distinct fragments with limited interactions and unequal QoL conditions. Formal and informal gating and walling of the fragments has led to different levels of security (at the plot, community and neighbourhood within the city) limiting interactions of the residents hence contributing to further fragmentation, lack of integration hence low QoL. Residential fragmentation is a complex phenomenon very much related to exclusion and spatial segregation although they are different problems in urban areas. The spatial inequality development in cities tends to increase the formation of fragments of poor settlements and wealthier neighbourhoods hence strengthening fragmentation. These issues tend to influence one another or exist in parallel within cities. It is therefore very important to study residential fragmentation with QoL.

In conclusion, combining the study of residential fragmentation and QoL and understanding their association seem to be useful to help to understand the urban issues in a multidimensional manner as well as help planning agencies and decision makers in formulating of policies that promote equity within the residential fragments. Previous studies fall short of analysing and quantifying the relationship of residential fragmentation and QoL. This research has therefore addressed that shortcoming in the literature by analysing the fragmentation and the QoL in the city of Nairobi.

6.2.   Limitation and recommendations

This study used case study approach to understand the relationship between residential fragmentation and QoL by analysing three residential fragments in the city of Nairobi. It is, therefore, necessary to emphasize that this was context-specific hence cannot be used to generalize to other cities since urban challenges are unique to the areas, neighbourhoods and people. It is thus not appropriate to build generalization on basis of the conclusion drawn from one case study. Notwithstanding, the findings could be adopted together with similar studies to form satisfactory generalizable conclusions. In addition, a wider scope of study with more

neighbourhoods included could be undertaken to validate and authenticate these findings and draw wider argumentation on the study.

There is a need for more detailed analysis to enumeration unit level that can enable place and people based policies. However, the demographic, social and spatial data for these units are not made public in Kenya. The study recommends that for more inclusiveness and transparency data at enumeration level should be accessible by the public and researchers. This will enable detailing out the variations of QoL and integration, which could be used to improve QoL of the urban residents by targeting on areas with low QoL conditions if planning in Nairobi moves towards more equitable policies.

6.3. Future research

There is limited literature on the study of gated communities, fragmentation and QoL studies in the city of Nairobi. This study contributes to enriching the literature and can act as a basis to open more research in the same field in the city of Nairobi as well as other cities with similar cases. More studies would enable comprehensive conclusions that can be useful for policy formulation for the city and country as well. It would even be an added advantage if universities in Kenya embark on studies in this field.

This study used dimensions and indicators of integration in order to measure fragmentation of the residential neighbourhoods (since integration is opposite of fragmentation). The study recommends that further research focus on the development of dimensions and indicators of fragmentation.

This study also recommends comparative studies. This can be in two-fold. First, whereby the fragmentation and QoL analysis of the other cities in Kenya can be done since the cities have the different historical background. Second, comparing and analysing similar study between cities in Global North and cities in Global South.

From the findings, it is evident that the use barriers like gates are not only applied within the planned /formal gated areas but also within the planned non-gated and slums as an aftermath requirement due to insecurities. For instance in the slum areas there informal gating within the quarters that are ethic based (40-60 households) creating fragments within the larger slum fragment. Based on this scenario, there is need for intra-fragment integration studies

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APPENDICES

Appendix 1: EpiCollect5 tool data collection preparation and execution

Creating Project adopted from Imperial College London (2018)

This tool allows use of any kind of form, each entry can be geotagged (using the phones or tablet GPS), and a photo attached (using the phones camera). It allows collection multiple entries on a single phone/tablet, stored within the phones database and later synchronizing with the project website.

Install the Epicollect5 App in the phone or tablet, Load the project using Gmail account and start data collection. Creating the and loading the project requires the following steps:

Create a Project website at EpiCollect.net → Design a form for data collection → Load Project into the EpiCollect mobile app and collect data, including GPS position and photos → View data collected at your project website or on your phone (download, view on maps/charts, filter.)

1. Create a Gmail account or use your personal account to log in in to the EpiCollect.net

2. Once logged in, click create project, a dialogue box appears. Provide suitable project name, brief description and form name as shown on figure a below:

epicollect5   Hi, Eunice   My Projects   ⊕ Create Project

Create Project

New Project   Import Project

Project name

Fragmentation and QoL

Max 50 chars

Small description *(A long description can be added later)*

Integration and QoL assessment

Max 100 chars

Form name

Fragmentation and QOL

Max 50 chars

Access
◉ Private ○ Public

CREATE

3. The project will be created and form builder opened. Using the drag 'n' drop form builder design a Form containing the kind of textual data you want to collect.

4. Load the Project into the EpiCollect app on your phone/tablet (and share your project with anyone else you wish to collect data). Select the project and click add entry to start data collection. Save each entry to be uploaded once there is internet connection. To upload the entries click on the arrow at the top of image (c).

a) Created project

b) Loaded project on the tablet

c) Adding new entries in the form using the tablet

5. Collect multiple sets of geotagged data, with (or without) photos. Synchronise data from your phone/ tablet with your project website. Collected data synchronized and uploaded in the project website. A screen shot of filled and synched forms is shown below.

View	Delete	Edit	Title	Created At	pick point	Dated	Interviewer	Neighbourhood	1. Do you think you
👁	⭕	✏	Mark kyallo	17th Oct, 2017	-1.321437, 36.788511	17/10/2017	Mark kyallo	Mugumoini	Slightly friendly
👁	⭕	✏	Mark kyallo	17th Oct, 2017	-1.321588, 36.78864	17/10/2017	Mark kyallo	Mugumoini	Completely friend
👁	⭕	✏	Ian	17th Oct, 2017	-1.322692, 36.799133	17/10/2017	Ian	Mugumoini	Completely friend
👁	⭕	✏	Sydney	17th Oct, 2017	-1.321581, 36.805133	17/10/2017	Sydney	Mugumoini	Completely friend
👁	⭕	✏	Mark kyallo	17th Oct, 2017	-1.322243, 36.789514	17/10/2017	Mark kyallo	Mugumoini	Slightly friendly
👁	⭕	✏	Ian	17th Oct, 2017	-1.322383, 36.799281	17/10/2017	Ian	Mugumoini	Completely friendly
👁	⭕	✏	Cynthia	17th Oct, 2017	-1.321964, 36.804582	17/10/2017	Cynthia	Mugumoini	Completely friendly
👁	⭕	✏	Mark kyallo	17th Oct, 2017	-1.322223, 36.78941	17/10/2017	Mark kyallo	Mugumoini	Slightly friendly
👁	⭕	✏	Sydney	17th Oct, 2017	-1.321685, 36.804892	17/10/2017	Sydney	Mugumoini	Completely friendly
👁	⭕	✏	Gerald	17th Oct, 2017	-1.321413, 36.788482	17/10/2017	Gerald	Mugumoini	Completely friendly
👁	⭕	✏	Ian	17th Oct, 2017	-1.32189, 36.799174	17/10/2017	Ian	Mugumoini	Slightly friendly
👁	⭕	✏	Cynthia	17th Oct, 2017	-1.322257, 36.804584	17/10/2017	Cynthia	Mugumoini	Completely friendly
👁	⭕	✏	Sydney	17th Oct, 2017	-1.321765, 36.804718	17/10/2017	Sydney	Mugumoini	Completely friendly

6. View data using Google Maps and Google Earth at your Project Website, or on your phone (Google Maps only).
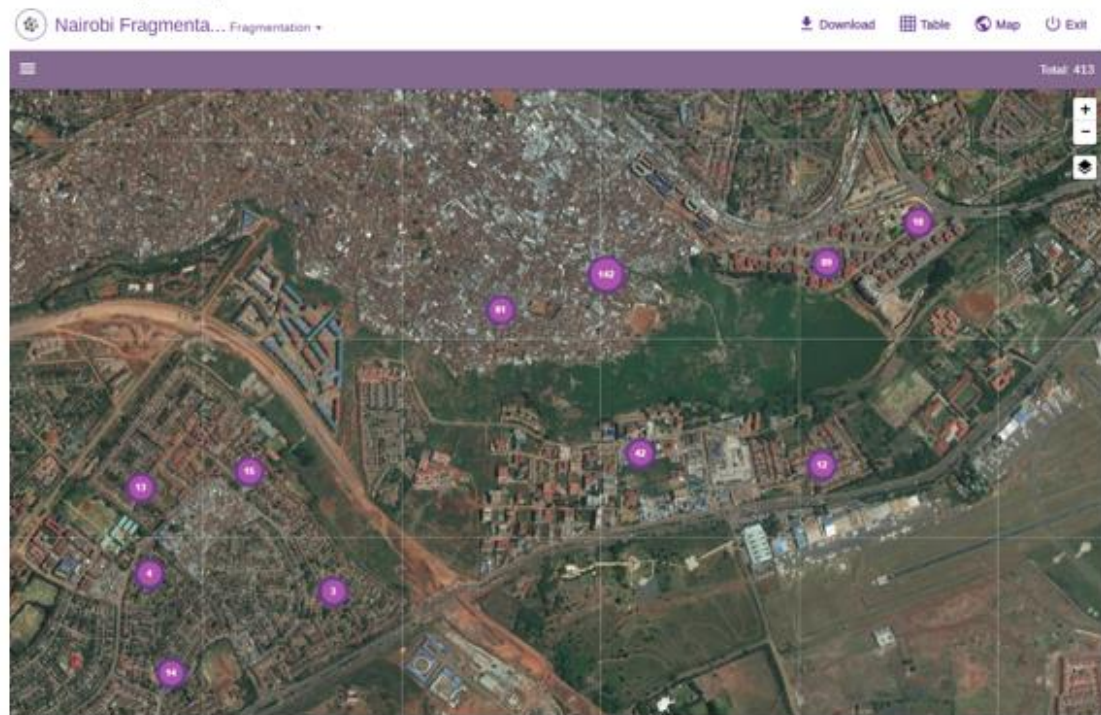
6. Download the filled forms in csv format for analysis

Appendix 2: Key informant interview guide
Introduction
My name is Eunice Jimmy a Msc student at the University of Twente Netherlands. I am undertaking MSc research project entitled *"Analysing the relationship between residential fragmentation and Quality of Life; Case of Nairobi City".* The purpose of this interview is to gather an in-depth information about residential fragmentation and Quality of life in the city of Nairobi.

Fragmentation is residential development that cause physical and social spaces to break up into bits that seem independent and detached from each other (Balbo & Navez-Bouchanine, 1995; Burgess, 2005; Landman & Badenhorst, 2012; Shawish, 2015).

Quality of Life as the relation between the individual perceptions and the feelings of people, and their experiences within the space they live in (Senlier, Yildiz, & Aktas, 2009)

The interview will be in three parts. Part 1 is about prevailing patterns of residential fragmentation in Nairobi and role of urban planning, standards and building codes in fragmentation. Part 2 is validation of fragmentation map and part 3 is domain of Quality of life validation. The interview is entirely for academic purpose and the information you provide will be confidential and treated anonymously. It will take about 45 minutes.

Part 1: Guiding topics
- History of fragmentation in the city versus emerging patterns
- Causes /reasons/drivers of fragmentation
- Effects of fragmentation
- Gated community development in Nairobi
- What are motivations and interest of residents regarding living in gated enclaves in Nairobi?
- Growth of slums versus gated and planned areas
- Updated list of gated and slums/informal settlements in the city
- What is the number of gated communities that have been approved by the City county of Nairobi (ask for an officer who would work with you to give u the list of gated communities in Nairobi)
- What do policy makers and urban planners know about residential fragmentation and QoL?
- Role of planning, regulation and standards to fragmentation in Nairobi
- Do you have regulations that guide the development of gated communities?

Thank you for your time

Appendix 3: Household Questionnaire

INSTITUTION: UNIVERSITY OF TWENTE
STUDENT: EUNICE NTHAMBI JIMMY
INTRODUCTION
Read: Hello, my name is ………………………… and I am here on behalf of Eunice Jimmy who is studying MSC at the University of Twente. Do you have some time to participate and answer questions for us? The interview should take 30 minutes.

About the interview

Read: Before starting the interview, I would like to briefly tell you about the purpose of this interview. I would like to know about your life in ……………………… (name the neighbourhood) especially on social relations and quality of life. People have different feeling and perceptions towards the neighbourhood they live in since their expectations and experiences are different. It is exactly this perceptions and feeling we are interested to know.

There is no right or wrong answer for this case since we want to know your experience. Your name will remain secret to us and the information you give will be anonymous. If you need any clarification during the interview kindly let me know. Do you have any questions before we begin?

PART 1: INTEGRATION (MEASUREMENT OF FRAGMENTATION)

a) Symbolic and community integration

Read: The following questions are about your interactions and contacts in the neighbourhood

Assessment Attributes	5	4	3	2	1
1. Do you think your neighbourhood is friendly?	Completely friendly	Slightly friendly	Neutral	Not friendly	Very unfriendly
2. How much do you feel at home in general in this neighbourhood?	Completely at home	Slightly at home	Neutral	Not at home	Completely not at home
3. How do you rate contact/ interaction between you and your neighbours in the neighbourhood?	Very good	Good	Fair	Not good	Bad
4. How many people in the neighbourhood do you chat with?	With all of them	With most of them	With just a few	Rarely	With no one
5. How well would you rate how you know your neighbours?	very well	well	fairly	poor	very poor
6. How often do residents within this neighbourhood ask for help?	Always	Often	Sometimes	Rarely	Never
7. Apart from the residents in your neighbourhood are there any other people across other neighbourhoods that you associate with on a social level?	Yes all of them	Yes most of them	With just a few	Rarely	None
8. How often do you interact (socialize) with other residents within your neighbourhood?	Always	Often	Sometimes	Rarely	Never
9. How many times would you ask any of your neighbours for help?	Always	Often	Sometimes	Rarely	Never
10. Do you feel some sense of pride being a member of this neighbourhood?	Completely proud	Slightly proud	Neutral	Not proud	Completely not proud
In the previous question, explain why you chose that answer on sense of pride in the neighbourhood					
11. Do you feel like you belong to (as a member of) this neighbourhood?	Completely belonging	Belonging	Neutral	Not belonging	Completely not belonging
In the previous question, explain why you chose that answer on belonging in the neighbourhood					

12. What type of interaction or relationship in the above do you have with your neighbour if any?
    1. Friends /family ( )   2. Business/ professional ( ) 3. No relationship ( )
       Other specify …………………………………………

   b) Functional integration

Read: This section has questions about how you access basic public facilities such as schools, health facilities, recreation areas and green spaces, water and electricity.

13. Where do you access the public facilities (health, education and recreation) and services?

Public facility	Place of access
Health	
Education	
Recreation	
Sports	

   1. Within the neighbourhood
   2. Within the neighbouring neighbourhood
   3. Outside the neighbourhood and adjacent neighbourhoods but within the city
   4. Outside the city
   5. Not applicable

Attributes	5	4	3	2	1
14. How do you evaluate access of sports facilities in your neighbourhoods?	Very accessible	Accessible	Neutral	Inaccessible	Very inaccessible
How long does it take to access sports areas by foot (minutes)?					
15. How do you evaluate the access of Recreation services and facilities (parks etc) in the neighbourhood?	Very accessible	Accessible	Neutral	Inaccessible	Very inaccessible
How long does it take to access Recreation facilities by foot (minutes)?					
16. How do you evaluate the access of kindergarten education facilities in your neighbourhood?	Very accessible	Accessible	Neutral	Inaccessible	Very inaccessible
How long does it take to access Kindergarten educational facilities by foot (minutes)?					
17. How do you evaluate the access of primary education facilities in your neighbourhood?	Very accessible	Accessible	Neutral	Inaccessible	Very inaccessible
How long does it take to access primary educational facilities by foot (minutes)?					
18. How do you evaluate the access of health facilities?	Very accessible	Accessible	Neutral	Inaccessible	Very inaccessible
How long does it take to access medical facilities by foot (minutes)?					
19. How do you evaluate connection of electricity?	Very accessible	Accessible	Neutral	Inaccessible	Very inaccessible
20. How do you evaluate availability of drinking water in the area (taped water)	Very available	Available	Neutral	Unavailable	Very unavailable
21. How do you evaluate the accessibility of clean drinking water in the neighbourhood?	Very accessible	Accessible	Neutral	Inaccessible	Very inaccessible

PART 2: QUALITY OF LIFE PERCEPTION

Read: The following questions are about perceptions and feeling you have and your experiences in this neighbourhood. It is your opinion on some domains of life.

Attributes	Level of assessment				
	5	4	3	2	1

Built and physical environment					
22. How satisfied are you with your housing in your neighbourhood?	Very satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
In the previous question, explain why the satisfaction /dissatisfaction on housing?					
23. How satisfied are you with the availability of green spaces in your neighbourhood?	Very satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
In the previous question, explain why the satisfaction /dissatisfaction on availability of the green spaces?					
24. How satisfied are you with the access you have to recreational areas within the neighbourhood?	Very satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
In the previous question, explain why the satisfaction /dissatisfaction on access to the recreational areas?					
25. How satisfied are you with the sports facilities in the neighbourhood?	Very satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
In the previous question, explain why the satisfaction /dissatisfaction on access to the sports facilities?					
26. How satisfied are you with the access of children playgrounds in the neighbourhood?	Very satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
In the previous question, explain why the satisfaction /dissatisfaction on children playground?					
Public service					
27. How satisfied are you with the access to kindergarten school facilities in your neighbourhood?	Very satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
In the previous question, explain why the satisfaction /dissatisfaction on access to kindergarten school					
28. How satisfied are you with the access to primary school facilities in the neighbourhood?	Very satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
In the previous question, explain why the satisfaction /dissatisfaction on access to primary school					
29. How satisfied are you with the access you have to public transportation (bus stop) in the neighbourhood?	Very satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
In the previous question, explain why the satisfaction /dissatisfaction on access you have to public transport					
a) Infrastructure					
30. How satisfied are you with the water provision in the neighbourhood?	Very satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
In the previous question, explain why the satisfaction /dissatisfaction on water provision?					
31. How satisfied are you with the electricity connection in the neighbourhood?	Very satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
In the previous question, explain why the satisfaction /dissatisfaction on the electricity?					
32. How do you evaluate solid waste management system in the neighbourhood?	Very satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
In the previous question, explain why the satisfaction /dissatisfaction on the solid waste management?					
Socio-economic					
33. How satisfied are you with the safety in the neighbourhood?	Very satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
In the previous question, explain why the satisfaction /dissatisfaction on safety.					

34. How satisfied or dissatisfied are you with your relationships with family or friends in the neighbourhood?	Very satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
In the previous question, explain why the satisfaction /dissatisfaction on the relationships					
35. How satisfied are you with the adequacy of family income?	Very satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
In the previous question, explain why the satisfaction /dissatisfaction on the family income					
Institutional					
36. How satisfied are you with the city County management and maintenance of infrastructure in the neighbourhood?	Very satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
In the previous question, explain why the satisfaction /dissatisfaction on the maintenance and management of infrastructure					
37. How satisfied are you with the city County provision of public facilities and services in the neighbourhood?	Very satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
In the previous question, explain why the satisfaction /dissatisfaction on the provision of public facilities and services					

PART 3: RESPONDENTS PROFILE

Read: This is the last section and has questions enquiring on your background information.

38. Gender

1. Male	**2 female**

39. Age ……………

40. What is your marital status
    1. Never married (　)
    2. Married monogamous (　)
    3. Married polygamous (　)
    4. Widowed (　)
    5. Divorced (　)
    6. Separated (　)

41. What is the highest education level completed
    1. None (　)
    2. Primary (　)
    3. Secondary (　)
    4. University undergraduate (　)
    5. University post graduate (　)
    6. Other tertiary colleges (　)

42. How long have you lived in this neighbourhood? ………

43. What is your employment status
    1. Employed (　)
    2. Not Employed　(　)

44. What are three most important reasons you choose to live in this neighbourhood?

1. Close to job	
2. Safety crimes and violent	
3. Convenient for Recreation activities	
4. Convenient for public transportation	
5. Close family and friends	
6. Convenient to school for kids	
7. Affordability and price to live in	
8. Better public services available	

Thank you for your time

Appendix 4: Box plots showing symbolic integration in the three fragments
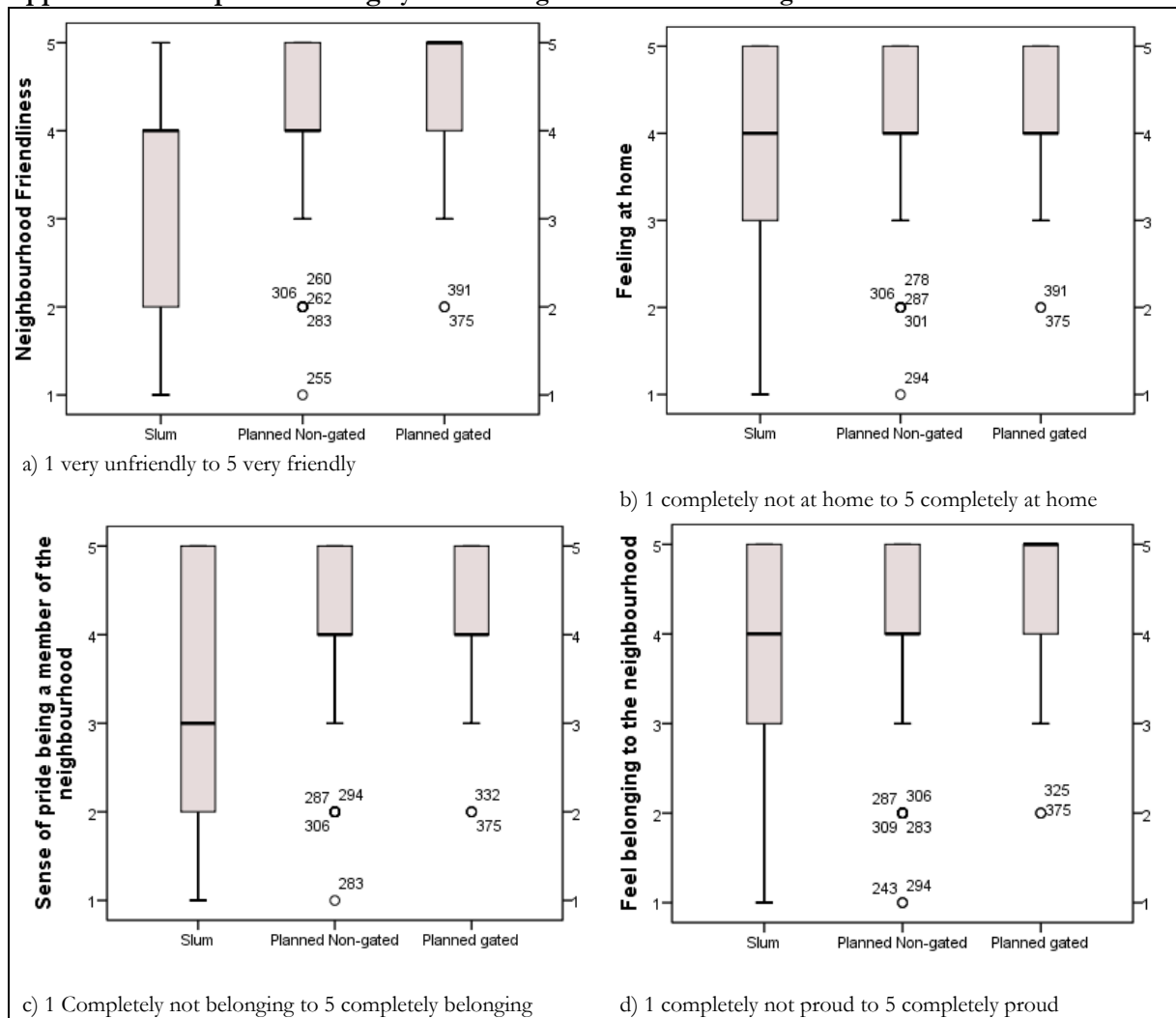
a) 1 very unfriendly to 5 very friendly

b) 1 completely not at home to 5 completely at home

c) 1 Completely not belonging to 5 completely belonging

d) 1 completely not proud to 5 completely proud

a) Do you think your neighbourhood is friendly b) Do you feel at home in the neighbourhood. c) Do you feel sense of pride as member of the neighbourhood d) Do you feel you belong to the neighbourhood.

Appendix 5: Box plots showing community integration in the three fragments

a)   1 bad to 5 very good interaction

b)   1 never to 5 always

c)   1 none to 5 all of them

d)   1 never to 5 always
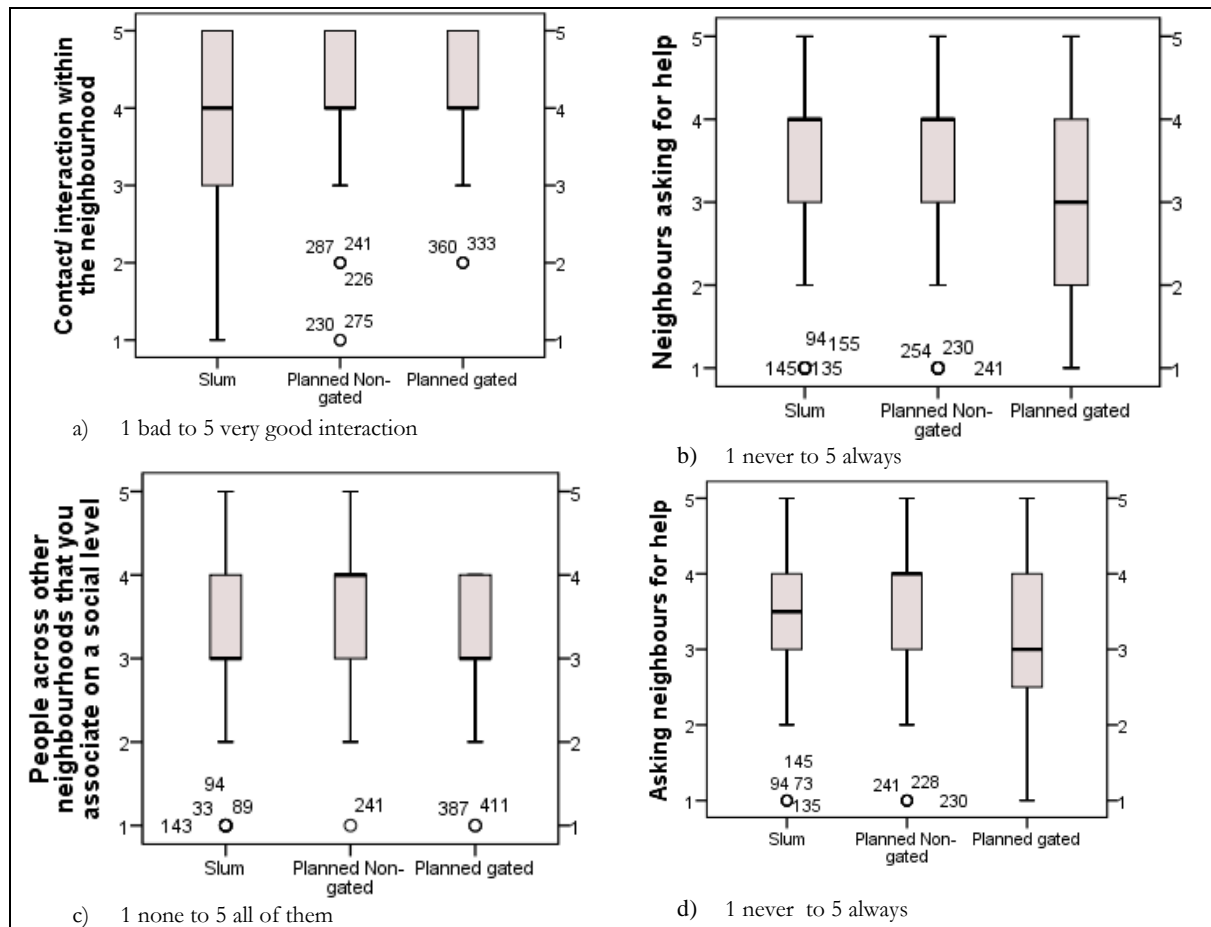
a)   Rate your interaction within your neighbourhood b) How often residents in your neighbourhood ask for help. c) Are there people across the other neighbourhoods socialize with d) How often do you ask your neighbours for help

Appendix 6: Spatial variation on QoL indicators

Satisfaction with relationships within slum and non-gated neighbouhoods

Satisfaction with relationships within the gated neighbouhood

Satisfaction with recreation areas within slum and non-gated neighbouhoods

Satisfaction with recreational areas within the gated neighbouhood

Satisfaction with family income within slum and non-gated neighbouhoods

Satisfaction with family income in gated neighbouhood

Appendix 7: T-test on integration and Domain QoL

Domain of QoL	Mean overall integration	N	Mean	Std. Deviation	Std. Error Mean
Mean built Environment	>= 3.89	202	3.70	.723	.05
	< 3.89	213	3.03	.58	.04
Mean Public Service	>= 3.89	202	4.19	.61	.04
	< 3.89	213	3.72	.65	.04
Mean Infrastructure	>= 3.89	202	3.92	.68	.05
	< 3.89	213	3.28	.74	.05
Mean Socio-Economic	>= 3.89	202	4.03	.54	.04
	< 3.89	213	3.32	.63	.04
Mean Institutions	>= 3.89	202	3.20	1.01	.07
	< 3.89	213	2.99	.80	.05

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
Domain of QoL		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Mean built Environment	Equal variances assumed	8.471	.004	10.40	413	.000	.671	.06454	.54443	.79814
	Equal variances not assumed			10.34	385.05	.000	.671	.06491	.54366	.79891
Mean Public Service	Equal variances assumed	.294	.588	7.55	413	.000	.465	.06164	.34404	.58636
	Equal variances not assumed			7.56	412.95	.000	.465	.06153	.34424	.58616
Mean Infrastructure	Equal variances assumed	4.130	.043	9.20	413	.000	.642	.06984	.50513	.77968
	Equal variances not assumed			9.22	412.41	.000	.642	.06967	.50546	.77935
Mean Socio-Economic	Equal variances assumed	11.081	.001	12.30	413	.000	.710	.05777	.59674	.82386
	Equal variances not assumed			12.34	409.53	.000	.710	.05755	.59717	.82343
Mean Institutions	Equal variances assumed	18.501	.000	2.43	413	.016	.217	.08945	.04121	.39290
	Equal variances not assumed			2.41	383.43	.016	.217	.08999	.04011	.39400

Appendix 8: T-test on integration and attributes of QoL

Attributes of QoL	Mean of overall integration	N	Mean	Std. Deviation	Std. Error Mean
Housing	>= 3.89	202	4.10	1.03	.07
	< 3.89	213	2.90	1.05	.07
Green spaces	>= 3.89	202	3.17	1.20	.08
	< 3.89	213	2.79	.82	.06
Recreational areas	>= 3.89	202	4.09	1.01	.02
	< 3.89	213	3.49	.98	.07
Sports facilities	>= 3.89	202	3.46	1.19	.08
	< 3.89	213	3.04	.84	.06
Children play grounds	>= 3.89	201	3.67	1.19	.08
	< 3.89	213	2.92	1.01	.07
Kindergarten services	>= 3.89	202	4.24	.84	.06
	< 3.89	213	3.58	.98	.07
Primary schools	>= 3.89	202	3.98	1.04	.07
	< 3.89	213	3.57	.98	.07
Public transportation	>= 3.89	202	4.36	.85	.06
	< 3.89	213	4.02	.69	.05
Water provision	>= 3.89	202	3.53	1.14	.08
	< 3.89	213	3.28	1.05	.07
Electricity connection	>= 3.89	202	4.54	.74	.05
	< 3.89	213	3.69	1.03	.07
Solid waste management	>= 3.89	202	3.70	1.43	.10

		N	Mean	Std. Dev	Std. Error Mean
	< 3.89	213	2.88	1.27	.09
Safety satisfaction	>= 3.89	202	3.96	1.12	.08
	< 3.89	213	3.01	1.25	.09
Relationships within the neighbourhood	>= 3.89	202	4.33	.72	.05
	< 3.89	213	3.54	.87	.06
Family income	>= 3.89	202	3.67	.98	.07
	< 3.89	213	3.11	.94	.06
Management and maintenance of infrastructure	>= 3.89	202	3.19	1.19	.08
	< 3.89	213	3.01	1.02	.07
Provision of public services	>= 3.89	202	3.21	1.15	.08
	< 3.89	213	2.96	.93	.06

Independent Samples Test									
		Levene's Test for Equality of Variances		t-test for Equality of Means					
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference
									Lower	Upper
Housing	Equal variances assumed	9.188	.003	11.757	413	.000	1.202	.102	1.001	1.403
	Equal variances not assumed			11.763	412.47	.000	1.202	.102	1.001	1.403
Green spaces	Equal variances assumed	35.895	.000	3.818	413	.000	.385	.101	.187	.583
	Equal variances not assumed			3.781	352.99	.000	.385	.102	.185	.585
Recreational areas	Equal variances assumed	2.370	.124	6.113	413	.000	.601	.098	.408	.794
	Equal variances not assumed			6.108	409.87	.000	.601	.098	.407	.794
Sports facilities	Equal variances assumed	57.933	.000	4.210	413	.000	.423	.100	.225	.620
	Equal variances not assumed			4.172	358.52	.000	.423	.101	.224	.622
Children play grounds	Equal variances assumed	7.306	.007	6.899	412	.000	.747	.108	.534	.960
	Equal variances not assumed			6.867	393.45	.000	.747	.109	.533	.961
Kindergarten services	Equal variances assumed	9.379	.002	7.309	413	.000	.655	.090	.479	.832
	Equal variances not assumed			7.339	408.48	.000	.655	.089	.480	.831
Primary schools	Equal variances assumed	.779	.378	4.069	413	.000	.402	.099	.208	.597
	Equal variances not assumed			4.062	407.63	.000	.402	.099	.208	.597
Public transportation	Equal variances assumed	29.873	.000	4.471	413	.000	.338	.076	.189	.486
	Equal variances not assumed			4.446	386.96	.000	.338	.076	.188	.487
Water provision	Equal variances assumed	1.666	.198	2.355	413	.019	.253	.107	.042	.464
	Equal variances not assumed			2.350	405.55	.019	.253	.108	.041	.464
Electricity connection	Equal variances assumed	21.932	.000	9.698	413	.000	.859	.089	.685	1.033
	Equal variances not assumed			9.781	384.84	.000	.859	.088	.686	1.032
Solid waste management	Equal variances assumed	1.058	.304	6.150	413	.000	.815	.133	.555	1.076
	Equal variances not assumed			6.132	402.07	.000	.815	.133	.554	1.077
Safety satisfaction	Equal variances assumed	20.415	.000	8.091	413	.000	.941	.116	.713	1.170
	Equal variances not assumed			8.115	411.71	.000	.941	.116	.713	1.169
Relationships within the neighbourhood	Equal variances assumed	10.059	.002	10.148	413	.000	.796	.078	.642	.951
	Equal variances not assumed			10.201	404.73	.000	.796	.078	.643	.950
Family income	Equal variances assumed	.108	.743	5.922	413	.000	.560	.095	.374	.746
	Equal variances not assumed			5.916	409.23	.000	.560	.095	.374	.747
Management and maintenance of infrastructure	Equal variances assumed	11.685	.001	1.649	413	.100	.179	.109	-.034	.392
	Equal variances not assumed			1.642	395.50	.101	.179	.109	-.035	.393
Provision of public services	Equal variances assumed	21.758	.000	2.487	413	.013	.255	.103	.054	.457
	Equal variances not assumed			2.473	385.59	.014	.255	.103	.052	.458